T. J. Hogan,
Cadet-Engineer,
~~3rd~~ Class.

Practice Cruise, 1876.

1876

U. S. S. Mayflower.
Journal of T. J. Hogan, Cadet Engineer

June 21 Reported on board Mayflower at 2 P.M. Engaged until supper in stowing locker. Went ashore for supper at 6.30 returned at 8 P.M.

The officers of the "Mayflower" are Comdr. H. L. Howison, Commanding, Lieut. T. B. M. Mason, Executive Officer, P. A. Engineer W. L. Nicoll, Senior Engineer Officer, P. A. Engineer D. Jones. P. A. Surgeon Moore.

The following is a list of the Cadets who are to cruise on the Mayflower this summer,

3rd Class.

1. Gatewood.	10. Lubbe.	19. Bartholow.
2. McFarland.	11. Harrison.	20. Yarnall.
3. Noell.	12. Norton.	21. Talcott.
4. Bowles.	13. Scribner.	22. Mercier.
5. Bennett.	14. Salisbury.	23. Bevington.
6. Hunt.	15. Carr.	24. Baker.
7. Annan.	16. Acker.	25. Bowers.
8. Bryan.	17. Hogan.	26. Isbester.
9. Elseffer.	18. Crygier.	27. Carter.
		28. Smith.

June 22. Went ashore for breakfast and dinner; took supper on board "Mayflower." We were allowed to remain ashore, in Academy grounds until 8 P.M. Hammocks down at 8 o'clock P.M. turned in at 10 P.M.

June 23. The cadets were organized for fire quarters to-day at about 10 o'clock A.M., after which they assisted in launching two boats from the wharf, and in hoisting them on board the "Mayflower". Stood watch from 12 M. to 2 P.M.

Fires were started at 10-45 A.M. got under way at 4-45 P.M. At 5-15 made fast to the Constellation and towed her out in the Bay, where she ran aground at about 6.30 P.M. Tugged at her for some time, but failing to get her off, returned to the Severn where we anchored at about 8. P.M. Was granted permission to go ashore in a boat that was sent off with the caterer; returned at 9. P.M. Went on duty as Officer of the Day at 10 P.M.; was relieved at midnight.

June 24th Turned out at 4 A.M.; stood watch in after fire room until 6 A.M.

The "Mayflower" weighed anchor at 4,50 A.M. and steamed down to the Constellation. Having pulled the Constellation off the bar the "Mayflower" returned to Severn river about 6.45 A.M.

Went ashore with caterer about 4 P.M. returned about 5 P.M. The weather being pleasant, turned in on hurricane deck, instead of in steerage.

June 25. At 10 A.M. the cadets were formed, under arms, on the hurricane deck and inspected by Comdr. Howison and Lieut. Mason; the cadets were formed in two lines facing inboard, the starboard watch on the starboard side, the port watch on the

port side; immediately after the inspection the cadets were formed in one line, (both watches) on the port side, facing outboard, and saluted Rear Admiral C. R. P. Rodgers who was passing in the str. Phlox, by presenting arms.

After inspection, church parties were allowed to go ashore. Went ashore about 10.30, to church, returned about 1 P.M.

Went on duty, as "officer of the day", at 10 P.M. was relieved by Mr. Bartholav at 12 o'clock, midnight.

June 26. Fires were started at 8 A.M. Got under way at 11.30. Took the Constellation in tow at 1 P.M. At 8 P.M., the Phlox, which had been towing alongside the Constellation, cast off and returned to Annapolis, the mail from the "Mayflower" having been sent on board the Phlox. Went on duty at 6 P.M. in forward fire room; was almost overcome by the heat, and had to leave fire room twice. Went off watch at 8 P.M. Turned in at 10 P.M.

June 27 Went on watch at 6 A.M.; was relieved at 8 A.M. Cast off from "Constellation" at 7.45 A.M. and steamed down the Bay until about 9.45 when we were signaled by the "Constellation". Returned up the Bay, and at 10.15 took the Constellation in tow and steamed down the Bay. At 6 P.M. cast off hawser of "Constellation", and came to anchor under banked fires

At 8 P.M. got up anchor and took "Constellation" in tow; turned in at 10 P.M.

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June 28 At 6.25 let go "Constellation's" hawser, and steamed in the direction of Norfolk, having towed the Constellation outside the capes. At 10 A.M. passed between Fortress Munroe and the Rip Raps. Between Fortress Munroe and Norfolk we passed a French Sloop of War, (Steamer) going out. Anchored at Norfolk, are several monitors, and a large French frigate, "The Minerve". The receiving ~~flag ship~~ "Worcester" is also anchored at Norfolk. The "Mayflower" was moored to the wharf at the Portsmouth navy yard at 12 M. Commenced to take in coal in the afternoon. Fires hauled at 2.15 P.M.

At 4.15 received permission to go ashore until sunset. Went through Portsmouth to ferry, and crossed to Norfolk, where I remained until 6.30 and returned to the "Mayflower" at about 7 P.M. Turned in at 10. P.M.

June 29 Did not get breakfast until about 9.00 A.M. Went ashore about 10 A.M., for the purpose of sketching in the navy yard; took a sketch of cupelo in the foundry, after examing machinery in the machine shops, and being instructed concerning the machinery by Passed Assistant Engineers Nicoll and Jones.

Returned to ship about 12.30 P.M. Went on

duty as "mate of the steerage" at 8 A.M. At 1.20 P.M. the tug Snow Drop came alongside and, after casting off from the navy yard wharf, took us in tow down to another wharf further down the river near the navy yard gate, but not outside the limits of the yard. About 2.30 P.M. went ashore, and on board the U.S.S. Alliance, now lying unfinished at the Navy Yard, for the purpose of sketching, under the charge of P.A. Engineer W.L. Nicoll. While on board of the Alliance took sketch of cross head. The engines of the Alliance are of the kind known as "compound". After remaining on board the Alliance long enough to have the engines explained to us, and to make a few sketches we were marched to the U.S. Coast Survey Steamer Bache, and after examining her engines we were marched back to the "Mayflower," at about 4.30 P.M. No liberty granted on shore after sunset. Turned in at 10 P.M. The engines of the "Bache" are also compound engines. In the "Alliance", the cylinders are horizontal and placed alongside of each other; in the "Bache" they are vertical and placed one above the other, the high pressure engine being on top. The engines of the "Bache" are direct acting, those of the "Alliance" are back acting.

&

June 30

Was relieved, as "mate of the steerage", by Mr. Salisbury, at 8 A.M. General liberty was granted to go on shore, from 9.30 A.M. until sunset.

Went ashore on leave at 3.00 P.M. Went by steam launch from navy yard to Norfolk, arriving in Norfolk at about 3.15 P.M. Left Norfolk at 5.10 P.M. and crossed by ferry boat to Portsmouth and returned to navy yard at about 5.35 P.M.
Commenced copying sketch of cupola at about 11.00 A.M. Turned in at 10 P.M.

LJ

July 1st Got fires lighted about 3. A.M. Left Norfolk about 6. A.M. Went on duty from 10 to 12 A.M. Went on duty from 10 to 12 P.M.

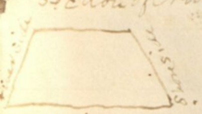
July 2nd Went on duty from 10 A.M to 12 M. Anchored off League Island, in the Delaware, about 6 mile below Philadelphia, at 11 A.M., when fires were banked.

July 3 Went ashore at League Island, for the purpose of inspecting the works at the navy yard. First, visited the Civil Engineers Office where we examined drawings of a quay to be built on the island. It is to consist of cribs built of heavy timbers which are interlaced by being notched together and then spiked. The cribs consist of several layers of timbers placed one above the other. One layer being parallel with the river and about one foot apart above these is placed another layer at right angles to the first and about 8 ft. apart, notched in and spiked to the first, above this comes a layer like the one below, and so on to the top. This is the construction used throughout the cribs, except in

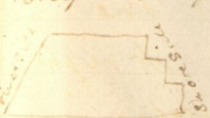
one part; about three feet from the bottom there is a floor built of timbers placed close together; this floor is for the purpose of preventing the cribs from sinking too deeply in the mud, and it also ~~answers~~ forms a base for the broken stone and other stuff with which the cribs are to be filled in. The cribs are built in any convenient place, in sections, and then launched and floated into position; the line of the quay is first laid out by driving piles on the proposed line, the cribs are floated up to this line of piles and when in the proper position are filled in and sunk.

The outside row of timbers are placed in a horizontal position one above the other, and touching, so as to form a solid wooden wall on the river front. All the timbers which run at right angles to the river instead of being simply notched in as the others are, are dove-tailed into the wooden wall on the front of the cribs, and notched into all other timbers. The outer wooden wall has a "batter" or inclination, in towards the shore, of a few feet, this is for the purpose of bringing the centre of gravity of the stone wall some distance inside the outside line of the base of the cribs. The inner part, that is the part nearer the shore, is built ~~shelvin~~ with projections like steps; it was the original intention to give the ~~o~~ inner side of the cribs an inclination or "batter" from the top down but as this would cause the earth behind the cribs to press it outwards, the other method was adopted; the method adopted causes the earth to

Section of Cribs.



original design.



method adopted.

press downward on the cribs. (See margin p. 7.)
On the top of the crib is placed a bed of concrete on which the stone wall is to rest. The top of the crib work will be four or five feet below the low water line, and the top of the stone wall will be about the same distance above the high water line. We also examined drawings of the foundations of buildings which are to be put up on the Island. As the ground, in most places, is not very firm it is necessary to using piles for the foundations. (See sketch book.) While we were in the Civil Engineer's Office we examined drawings of a "sectional, balance dry dock", and after leaving there we examined a "sectional floating dry dock". The "sectional balance dry dock" is built in sections, and when it is necessary to take in a ship the sections are filled with water by opening valves arranged for that purpose, and in this manner the dock is lowered; it is raised by pumping the water out of the sections, the pumps being placed on both sides some distance above; in order to balance the dock, in case that any part is too high or too low, the sections are divided into compartments which may be filled with water or emptied. The "sectional" dock that we examined had, on both sides and immediately under the pumps large air tight sections, which by being raised or lowered, ~~raised or l~~ lowered or raised the main part of the dock. Returned on board Mayflower at 1.30 P.M. Got under way at 2.15 P.M. and anchored in the Delaware at the foot of Fairmount Av. about 3.50 P.M. Went on duty in the upper engine room at 2. P.M. was relieved at 4 P.M.

H

July 4 General liberty was granted on shore until

sunset. Went on shore about 9.30 A.M. returned about 7 P.M. E.J.

July 5th Remained on board ship all day, ~~putt~~ing in sketches. N

July 6th. Went on duty as officer of the day from 2 A.M. until 4 A.M. W. At 8 o'clock one-half of the class (the starboard watch) went ashore to visit the Centennial grounds; arrived at the grounds about 9.45 A.M., under the charge of P. A. Engineer Nicoll, and were marched to "machinery hall", where the different machines, that we were able to examine in the morning, were explained to us. On entering the hall the first thing that we examined were some very large forgings, from Germany, of plate steel ~~iron~~ with flanges, one piece being a cylinder head about 8½ ft. in diameter and ⅞ ins. in thickness with a large flange turned on it; the steel ~~iron~~ in all of these forgings was perfect and showed no signs of splitting. In this department there are also a great many specimens of coal and iron, and a large shaft, or column, made of pieces Speigleisen; a mineral found in Germany, and much used for making steel. The base of the column is made of the mineral in its natural state, and the shaft is made of the metal. This speigleisen contains a great deal of manganese. We also examined a model of the largest pumping engine in the world. This engine is near Ferrara in Italy, it is a compound engine, and has a cut off valve on the small cylinder only. The

steam exhausts into the discharge water.
We next examined, and had explained to us, Clark and Stanfield's patent Gridiron Stages and Depositing Dock; this is in the department of Great Britain and Ireland. In the same department we saw some specimens of Iron plating for H. B. M. ships "Inflexible", "Temperaire", and "Rupert" 2, 7, and 11 ins. in thickness, manufactured by C. Cammel & Co. Sheffield, Eng.
In the American department we examined several planing machines, a hydraulic portable rivetter, a machine for boring wheel hubs, a shearing machine capable of cutting 1 inch cold iron 5 feet wide the latter, we saw in operation, and a gear cutting and nutting machine, punching machines, drill presses, a bolt cutting machine, and a machine for shaping hexagonal nuts. All of the above were from Sellers and Co., Philadelphia.
From the manufactory of Pratt, Whitney and Co., Hartford, Conn. were the following ~~artic~~ machines which we examined, machines for making screws, all the work being done by one machine; a cartridge varnishing machine, a spiral spring machine, a machine for rifling gun barrels, the twisting motion being given by means of an upright ratchet attached to a slide block which moves in an inclined slide, the ratchet working into a pinion attached to the horizontal rod which works the tool; a dye press, and a "Revolving Head Chucking Machine".
After leaving here we examined a very large gear cutting machine manufactured by Corliss & Co.; we did not examine the large engine.
In the German department we saw a large forging

of a shaft, in the rough, from Krupp's works, and another of a finished shaft, of the same size. We also saw the large Krupp gun, 60 tons.

Having examined all of these machines at half-past twelve we were dismissed to make sketches, and at 1.30 assembled near the entrance to the hall, and after having our sketches examined by P.A. Engineer Nicoll we were dismissed for the day; after getting lunch I went through the Art gallery, and returned to the ship about 5.30 P.M. N

July 7th. Remained on board Mayflower all day, writing up journal and sketch book. N

July 8th. Went ashore about 8 A.M., and visited the Centennial Exposition under charge of P.A. Engineer Nicoll.

In the space occupied by Sellers & Co., examined Rotary Puddling furnace. In space occupied by A. Garrison & Co., Pittsburgh Penn., Chilled Roll for rolling plate iron; Diameter of body 31 ins., length of body 96 ins., made for Union Iron Company of Buffalo, N.Y. In the Canada department we examined some iron ship's knees.

In the Russian department we examined specimens of rolled steel, and sheet copper, one sheet of copper being 30 ft long and 3 ft. 6 ins. in width, and others about 6 ft. in width but shorter. Also specimens of Malachite, and some very thin rolled iron ~~steel~~ not thicker than ordinary writing paper. All of the above are from the mines of Paul Demidoff, Prince of

San Donato. Among the other things which we saw in the Russian department were a circular iron clad having six screws, the hull being circular; ~~and~~ also a very curious engine having no connecting rod the piston having a rectilinear motion and being connected with the shaft by several small cranks; the cylinder is fixed, that is, it does not oscillate.

John Roach & Son's space. Plate iron ~~30~~ 25 ft. long ~~3½~~ 8½ ft. wide ⅝ ins. thick. Models of engines of steamers City of Boston and City of New York. Model of monitor

"Puritan" 350 ft. long 55 ft. beam, 2 turrets. Also models of engines of steamers "Bristol" and "Providence", Long Island Sound Steamers. We also saw several specimens of flange work and boiler iron, one boiler head 106 ins. in diameter.

Examined model of Cox's Improved Coffer Dam for making possible the removing of propellers and repairing the ends of ships, while loading or unloading; it is made of iron, with air tight compartments.

Examined a type making machine of the most improved pattern, also one used in 1796, the latter being merely a small hand mould.

In the Russian department is a space allotted to the Imperial Technological School of Moscow which contains a very interesting collection of all the tools used in the mechanic arts. Tool for laying off crank shafts; one very interesting and useful instrument for laying off arcs ~~wit~~ of any radii without finding the centres or using any kind of compasses.

Made a sketch of the engine mentioned as having been seen in the Russian department. We were dismissed about 1.30 P.M.; after spending the greater part of the afternoon in the Art Gallery Annex, returned on board ship about 6. P.M.

N

July 9th. Went ashore to church about 10.30 A.M. returned at 1 P.M. did nothing of importance during the balance of the day. Went on watch as Officer of the day from 8 to 10 P.M.

N

July 10th. Remained on board "Mayflower" all day writing up journal and putting in sketches.

July 11th. Went ashore to visit the exposition at about 8 A.M., under the charge of P.A. Engineer Jones. The first thing we did was to have the Corliss engine explained to us; it is of 1400 horse power, diameter of cylinders 40 ins, length of stroke 10 ft. We also examined the boilers belonging to this engine they are some distance from the engine and outside of the main building underground. The boilers are 20 in number but only four half of them are in operation at the same time, they are four feet in diameter; at the time that we examined the boilers the pressure was between 17 and 18 lbs. at the boilers and 15 lbs. at the cylinders. We next visited the "Hydraulic" department where we saw and examined several blowing machines for cupola furnaces and forges, and one very large machine for ventilating mines; mining pumps for raising

water from mines; Blake's oil line pump with removable cylinder for pumping oil in mines; Sewall and Bagley's Rotary pumps; centrifugal pumps; Double Propellor pump, manufactured by Lewiston Machine Company, of Lewiston Maine; Gould's Hydraulic Ram; a dynamometer, bearings and propellors made of a new metal called Phosphor-Bronze; several air compressors, one of them to work drills in Hoosac tunnel; a coke oven; machine for crushing rock; several marine engines; the Shive governor; an engine with a valve having an area of 133 square inches worked by a wire 1/4 in. in diameter; J. W. Griffith's (Boston) machine for bending ships timbers. We were dismissed at 12,45 P.M. and as I was obliged to return to the "Mayflower" as soon as dismissed, I returned to the wharf at which we landed in the morning, but found that the "Mayflower" had shifted her anchorage, and was some distance farther down the river, between Smith's Island and the New Jersey shore; took the ferry boat to Smith's Island and steam launch from there to the "Mayflower".

July 12th. Remained on ~~board~~ all day writing up journal &c.

July 13th. Went ashore under charge of Mr. Nicoll and visited the Exposition. We visited the boiler department, where we examined several boilers; "the Wiegand patent sectional safety steam generator", manufactured by the Steam Generator Manufac-

turing Co. of Pensylvania No. 30 North Fifth St. Phila.; Reed's Portable Safety Boiler, manufactured by J. A. Reed, 113 Liberty St. New York; Andrew's patent Superheating Tubular Steam Boiler, Wm. D. Andrews & Bro. manufacturers 414 Water St. N.Y.; Firmenich's Wrought Iron Tubular Safety Boiler, Joseph & G. Firmenich Buffalo, N.Y.; The Harrison Steam Boiler; after leaving the boiler department we examined the different parts of the Harrison Boiler and the manner in which the globes, of which the tubes are composed, are fitted; they are fitted with a rebate joint, very accurately, no packing being used. We also examined the L. B. Tupper grate bar, and a water wheel manufactured by the Capron Water Wheel Manufacturing Co. Hudson N.Y., an Iron Penstock or Casing containing Leffel Turbine water wheel with inlet pipe and gearing for transmission of power, manufactured by Poole & Hunt Baltimore, this was a very large casting; we also saw a large screw blade, for Red Star line of Steamships. In the boiler department we also saw Roger and Black's Patent Circulating Boilers, and three or four different kinds of injectors. One very interesting machine was the Hydro-Carbon Engine. About 12 o'clock we were dismissed to take sketches and meet again at 1 o'clock. I took sketches of an engine in the Russian department, and of a governor. Returned on board at 6 P.M.

July 14th Remained on board "Mayflower" all day, writing up journal and putting in sketches. Went on duty as "Officer of the Day", at 8 A.M., was relieved at 12. M.

July 15th Starboard watch went ashore at 8 A.M., under charge of P.A. Engineer Nicoll, and visited the Centennial Exposition; the first thing that we examined was Orum's Patent Mandrel for Bending Metal Pipe. We went through nearly all that part of Machinery Hall that we had not visited before, and examined a yacht engine, a "Counter" suspended by a strap through which is passed a wire, the counter being run by means of electricity; the Allen Governor, Ashcroft Gauge, Waters Governor, Baxter's Portable Steam Engine; one peculiarity of this engine is that the cylinder is situated in the steam space of the boiler, one of those engines consumes but 3 lbs. of coal to a horse power per hour; we also had explained to us a balance slide valve, patd. by J. A. Tonhill, of Pittston ~~Pittsburg~~ Pa., this valve is worked by a wire 1/4 in. in diameter, ~~and~~ is balanced ~~so as to~~ slides on rollers, and admits steam through two ports at the same time, one of the ports being placed the same as in an ordinary valve and the other directly opposite between the first and the cylinder. We also examined a patent block for eccentric hooks, patented by J. F. McCutchen Phila. Pa., Riehle Bros.' Testing Machine, Phila.; we saw a rod, 3/8 in. in diameter, tested, it broke at 6240 lbs. We examined sections of Wire Cables manufactured by John A. Roebling's Sons, Tren

ton, N. J.; section of cable of East River Suspension bridge, composed of 6000 No. 7 Galvanized Cast Steel Wires. Ultimate strength of Cable 22,300000 lbs. Niagara Railway Suspension Bridge 3640 Iron Wires No. 9 Gauge, strength 6 000000 lbs. Covington & Cincinnati Suspension Bridge, 5180 Wires No. 9 gauge 8,424,000 lbs. W. A. Roebling Chief Engineer. We saw the Ephrata Printing Press known to be over 130 years old, on which were printed 100 years ago, copies of the Declaration of Independence, the Continental Money &c.; bought a copy of the Declaration printed on this press. Also saw the cylinder of the first steam engine used in the United States. I returned on board the "Mayflower" at about 2.30 P.M.

July 16th Went ashore to church about 10 A.M., returned about 1.45 P.M.

July 17th Remained on board all day putting in sketches &c. Was on duty, as Officer of the Day, from 12 M. to 4 P.M.

July 18th Went ashore under the charge of P. A. Engineer Nicoll and visited the Centennial Exhibition. Visited Boiler Shop No. 1 and examined boilers of W. & J. Golloway & Sons, of Manchester, England. In one of the "Annexes" to the Machinery Hall we examined a surface grinding machine Patd. by J. H. Sternbergh, Reading, Pa., and a printing type mould used by the publishers of the New York Herald; a "matrix" is made of several thicknesses of tissue

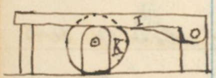
paper and one of linen paper, on this is put a preparation of glue & flour containing a quantity of alum; after the type has been set an impression of it is made on this preparations & this is called matrix, the matrix & it is then placed between two hollow half-cylinders, and molten type metal poured upon it, which forms the new type for printing the paper. In another boiler shop we examined the Pierce Rotary Tubular Boiler, and the "Anderson" Sectional Water Tubular Boiler, manufactured by Mast, Foos & Co., Springfield, Ohio. In the saw mill building we examined a very finely polished engine with a peculiar cut-off arrangement, and in the same building we saw several saws for cutting stone one, having the diamonds set in a peculiar manner, manufactured by J. W. Branch, we also examined a band saw, which worked around the wheels in the same manner that an ordinary band does, the joints being brazed; we also saw in the saw mill building "The Wells Two-Piston-Balanced Engine", an engine having two pistons working in opposite directions, and at each stroke moving one-half the length of the cylinder, the piston nearer to the cross-head has two piston rods, the other piston has one piston-rod, which passes through the centre of the first piston, the three rods coming out at the same end of the cylinder. After leaving the saw mill building we passed through the Machinery Hall and went to the Main Building, where we saw the following; several very large bolts about 4 ins. in diameter, bent cold with thread on; specimens from the works of the "Chrome Steel Co. of Brooklyn,

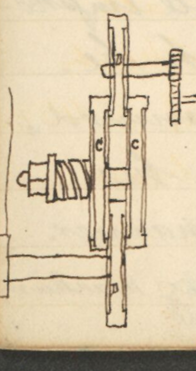
N. Y.; a model of Raritan Bay Pivot Bridge, 472 ft. span, the longest swinging bridge in the world, constructed by the Keystone Bridge Company, Phila. Penn.; guns manufactured of (Bronze Steel) Condensed Bronze, by the South Boston Iron Co. After leaving the Main building we visited the French building of Public Works containing models and drawings of bridges, canals, lighthouses tunnels &c., after which we were dismissed for the day; returned on board at 6 P.M.

July 19th Remained on board "Mayflower" all day, putting in sketches and writing up journal.

July 20. Both watches went ashore, at about 8 A.M. under the charge of P.A. Engineers Nicoll and Jones, and visited the manufactories of Sellers and Co, and Wm. B. Bement & Son; in the manufactory of Sellers & Co. we were conducted through the different shops by Mr. Coleman Sellers one of the members of the firm of Sellers & Co.; he explained to us most of the machines that were of interest, and gave us a great deal of information concerning machinery in general. In the works of Sellers & Co everything is carried on in a very systematic manner. Mr. Coleman Sellers created a very favorable impression on the cadets, from the manner in which he explained the different things which we examined. All were of the opinion that he understood his business thoroughly, and in a scientific manner. In the machine shops we saw the following machines:

gear cutting machines; machine for grinding flat surfaces, this machine consists of a smooth plate I upon which the work is placed, in the centre of the plate is a hole in which the emory wheel K works, the periphery of the wheel being on a level with the surface of the table, and not at all projecting; (see margin). testing machine; turning, boring, and planing machines; planer, shaper, and slotter, combined, for planing bed plates of marine engines, built for navy yard at Cronstadt Russia; steam hammers; they have a separate store-room where there is nothing kept but injecters and the parts of injecters. We saw in operation a sand blast for cleaning brass castings, and examined a large vat filled with 5 parts water and 1 part sulphuric acid, in which iron castings are placed to be cleaned; the sand blast is used for brass castings only and the sulphuric acid and water for iron. We examined the foundry which is in a large building 80 ft. by 275 ft., and the blacksmith shop, where we saw a steam hammer in operation; in order to show us how well the hammer was controlled, Mr Sellers took an ordinary brass pin and had it driven into a piece of inch board without bending the pin, or putting a mark on the board. After going through these shops we went to the drawing-room where we saw a great many drawings of machinery. On a boring machine in the machinery department we saw a very ingenious arrangement for increasing the speed of the tool. c c are two brass discs between which two other discs D D run; the upper





disc marked D works on a spindle on which is the gearing which runs the tool; the lower disc marked works on a spindle connected with the belting; the discs c c are so arranged that they can be raised or lowered, and as they take hold of different parts of the other discs the speed is increased or decreased. The epicycloidal form of teeth is the best for heavy strains. Regarding friction, the increase of surface to a certain point is advantageous. The works of Sellers & Co. occupy two whole blocks, the office is on the corner of Hamilton and 16th Streets; we left there at about 11.30 and went to the works of Wm. B. Bement and Son, the principle machines that we saw there were steam hammers, machines for forcing car axles into wheels, having a pressing power of 150 tons; horizontal and vertical planing machine 8'x12', gear cutting machine, drilling machine on pivot arranged so as to swing around to any position, machine for boring car wheels, a bolt cutting machine, lathe for turning car axles, and a large lathe for boring bearings; planing boring and turning machines with circular table and ~~helicoidal~~ having Schiele's curve for bearing surface bed; after going through the shops we visited the drawing rooms and examined a few drawings, after which we were dismissed, all hands returning on board at about 2.30 P.M. Spent the afternoon in writing up journal. About 5.45 P.M. Lieut. Mason left the "Mayflower", having been detached.

July 21. Went ashore about 8 A.M., under charge of P. A. Engineer Nicoll, the first place that we visited was the ship yard of Wm Cramp & Sons, here we saw punching machines, rolls for bending plates of iron, shears for cutting flat iron and angle iron, a large planing machine with tools for ~~working~~ cutting in ~~opposite~~ both directions, machine for countersinking. Most of those machines were made by Bement & Dougherty. We also saw a plate furnace and angle iron furnace for heating plate and angle iron, also a table upon which angle iron is bent and a mould on which large plates are bent; machine for bending garboard strakes the garboard strake is used for fastening the ribs to the keel in a vessel with a bar keel; we examined the monitor Terror which was being built at this yard, it will have water-tight compartments every 20 ft.; these compartments are filled with water when the ship is in action, which will cause it to sink lower in the water, when not in action the water is pumped out; the "Terror" will have two turrets, the ~~bases~~ rings of the turrets will consist of 4 thicknesses of 3 in. ~~plate~~ iron. In the boiler shop we saw a large shell of a boiler 12 ft. in diameter, rivetted with Sellers' rivetting machine; we also saw two 15 in. guns for the "Terror". After going through the shops we visited the drawing room.

After leaving the works of Cramp & Sons we visited the Port Richmond Iron Works of I. P. Morris & Co., where we went through the foundry and machine shops we saw here several large pieces of

machinery, a bed plate for large compound engine, a large cylinder with jacket, and parts of sectional fly wheel. We also examined and had explained to us Carré's Refrigerating Apparatus; in one of the shops we saw a very large pumping engine which was being put together. After going through the shops we visited the drawing room where we examined some drawings of a large pumping engine for the Calumet & Hecla Mining Co. In the machine shop we examined the gun of a Shaw's gunpowder pile driver.

We next visited the Neafie & Levy Penn Works we did not spend much time here as there was no work being done, as it was dinner hour, after leaving here we were dismissed and returned to the "Mayflower". At the Penn Works we saw a very beautiful steam yacht.

July 22 Was very suddenly taken sick this morning at about 1 A.M. and was not able to turn in until about 4.30 A.M. All of the cadets were given liberty on shore from 10.30 A.M. until sunset; I was unable to take advantage of this as I was very sick.

July 23 Started fires at 8.30 A.M. Weighed anchor at 1.50 P.M. Arrived at Chester Penn. at 4.00 P.M. Hauled fires at 6 P.M. Was on the sick list all day.

July 24 The cadets went ashore about 8 A.M. and went through the works of John Roach & Son. In the morning they made no sketches but took notes; they went ashore in the afternoon for the purpose of sketching. I remained on board, on the sick-list.

EJ

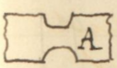
July 25 Remained at Chester until about 2 P.M. when the hawsers were cast off, and the ship steamed down to Edgemoor, Del., where the ship ran aground while going into the wharf. Arrived at Edgemoor at about 3.50 P.M. At 8 A.M. my name was taken from the sick list.

EJ

July 26 At 2.45 A.M. the ship was floated off by the high tide, when she steamed out into the middle of the stream, and came to anchor at about 2.55 A.M. At 8.30 A.M., all of the cadets went ashore to visit the Edgemoor Iron Works, of Sellers & Co. We ~~wer~~ were shown over the works by Mr. William Sellers, who explained the different machines to us, and gave us a great deal of information. The same systematic arrangement, and modern improvements are to be seen here, that we noticed in the works of Sellers & Co in Philadelphia. The first machine that we saw was a machine for testing iron, and while we were there they were testing the braces which are to be used on a bridge which is to be built across the Kentucky River, for the Cincinnati Southern Railroad Co. This bridge will be 1125 ft. long, it is to be

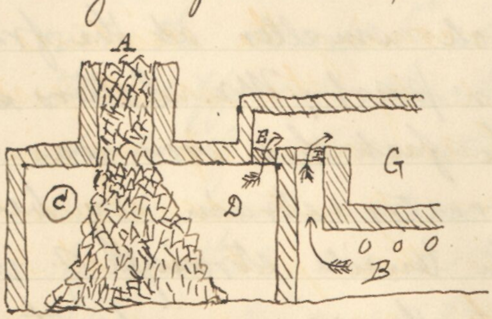
built in three spans, and will be the highest bridge in the world. It is required by the rail road company that these braces should have a certain modulus of elasticity ~~enough to stand a pressure of 25000 lbs.~~ ~~to the square inch~~; in testing the braces a pressure of about 20000 lbs. to the square inch is put on them; when this pressure is put on it stretches the braces about $\frac{110}{1000}$ ins., and when the pressure is taken off the iron returns to its original size, if it has not been given a permanent set by the pressure; if the iron receives a permanent set it does not return to its original position and is rejected as not being strong enough. These braces are about 1¼ ins. thick 5 ins. wide and about 30 ft. long.

Mr. Sellers showed us a piece of fine homogeneous iron which had been broken by a pressure of about 35000 lbs. to the square inch; we examined the fracture made, and noticed that the size of the iron was much smaller at the fracture than at any other part; Mr. Sellers said that this accounted for the fact that iron was often made to stand a much greater strain by being tested in another way, the tensile strength of iron being counted as 60000 lbs. to the square inch; the common way of testing iron is to notch it out as shown in the margin and put on the pressure until the iron breaks; it will naturally break at the small part where it is notched, but it will stand something greater than the actual strength of the iron can bear, this is because the notch forms



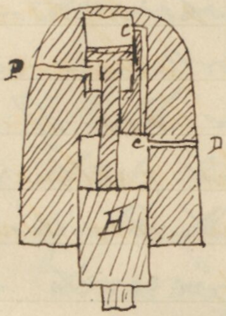
a shoulder which supports the iron when it tends to draw ~~together~~ asunder at the fracture, and makes it much stronger; this is the case when the shoulders of the notch are close together; in order to get a fair test, the distance between the shoulders of the notch should be at least six times the diameter of the iron, that is if the iron is notched at all, although it may not always be necessary to notch it. A piece of iron which had stood a pressure of 70000 lbs. to the square inch when tested in the common way, was broken by a pressure of 35000 lbs. by the other method.

We saw in one of the shops a hydraulic welding machine by which a pressure of from 2000 to 5000 lbs. per inch was brought to bear on the hot iron that was to be welded; this machine welded the iron at one stroke; the iron was heated in a gas furnace, to a welding heat.

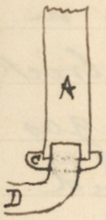


The furnace is constructed as shown in the sketch. Coal is put in through the opening A, and the heap takes the form shown in the sketch. Air comes in through the opening C and coming in contact with the coal, which is burning slowly, forms carbonic acid gas, this passes through the coal and comes out into the chamber D, in the form of carbonic oxide, it then passes through the opening E, and is mixed with the air which comes up through the opening

F', from the chamber B; after mixing with the hot air from B, the gas is ignited and burns in the furnace G; the openings E and F' are of brick open-work so arranged that a space where gas comes up is opposite to a solid brick in F', and between two air-spaces in E'; this is for the purpose of mixing the air and gas. In the same shop we saw a large hydraulic punching machine, with which the workmen were then punching the eyes in some large braces. Near to the large punching machine is a large hydraulic accumulator. The hydraulic welding machine works



on the principle shown in the sketch; in order to send the hammer down, pressure is admitted above the large piston H through the opening D, at the same time it is allowed to pass through the passage c in above the small piston, thus overcoming the resistance that might be otherwise caused by the small piston; in order to bring the hammer up again the pressure is taken off from D and consequently from c, and pressure is then put on at P which raises the hammer; this arrangement is for the purpose of doing away with the use of valves, which would be very expensive, Mr. Sellers informed us that water used in hydraulic works should not contain any iron, as it would unite with the tannic acid in the leather which is used in packing and make the leather very hard and useless



as packing. We also saw a very large steam hammer, at work, which had a peculiarly arranged exhaust pipe. (See sketch in margin). The steam comes from the hammer into the pipe D and passes up into the pipe A which goes out above the roof. The pan C is fixed to the top of the pipe D; D projecting about three inches up into the large pipe A which is suspended from the roof and does not touch the pan C nor the pipe D. The condensed steam falls down in the pan C and is carried of by a drain pipe. The pipe is arranged in this manner to prevent the hammer from jarring the pipe. We also visited the rivetting shops where there is nothing done but rivetting, the workmen were then engaged in rivetting the beams of the large bridge already mentioned, all of the rivetting machines are worked by hydraulic pressure. Two of the machines are so arranged as to be swung into any required position. I made a sketch of one of them, to be put in my sketch book. In one of the shops we saw a chord boring and rotary planing machine, the boring and planing is done on one machine for the purpose of getting the axes of the large pins and the edges of the chords in perfectly parallel planes. We also saw several large rotary planing machines, some of them having about forty tools in the stock. In the same shop we saw a saw for cutting cold iron at any angle. We examined a very ingeniously contrived

dividing apparatus for dividing work into spaces; also a very large punching machine, arranged to work from one to six punches either one at a time, all together, or two, three, four, or five at a time. Besides all of these machines we saw a great many that we had seen in other places, and that have been already mentioned. We returned on board at about 12 M., and at about 3.30 P.M. we weighed anchor and steamed down to Wilmington where we arrived at about 4.30 P.M. A short time after our arrival at Wilmington Lieut. Duncan Kennedy came on board as executive officer.

D. J.

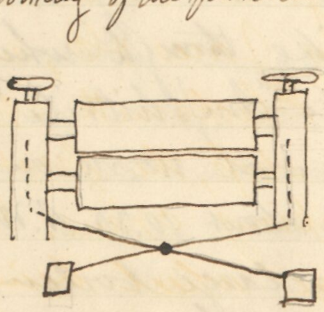
July 27. Both watches of the cadets went ashore at about 8.30 A.M. and visited the drawing room of The Harlan & Hollingsworth Company; in the drawing room we examined drawings of the monitor "Amphitrite", which is being repaired at this yard by being rebuilt. After leaving the drawing room we went on board of the "Amphitrite", which we examined thoroughly; we saw the workmen at work making the pattern for the flange on the stern pipe through which the shaft passes. After leaving the "Amphitrite" we returned on board, and commenced work on our journals and sketch book, at about 10.30 A.M. At about 11.30 we went ashore to see a large boiler hoisted out of the Steamship Lone Star; this was one of two boilers which had been in the vessel and were

being taken out. The boiler that we saw hoisted was 13½ ft. in diameter and weighed 43000 lbs.; it was hoisted by means of a large shears on the wharf. We returned on board at about 12.15 and remained on board all the afternoon.

July 28 Both watches went ashore at about 8.30 A.M. The first place that we visited was the rolling mill of Seidell & Hastings which was then in operation; when we were there they were rolling plate iron. The first thing to be done in the rolling of these plates is to make what is called a "pile" by taking one sheet of plate iron, and on this putting layers of scrap iron to any thickness, according to the required thickness of the iron; this "pile" is put in a reverberatory furnace, and when it is heated to a welding heat, it is taken out by means of a "peel" and put on the table near the rollers and passed between the rolls; after it passes between the rolls it is lifted up on an apron, above the rolls, and thrown back again to the place from which it started, when it is again passed through the rollers; the rolls being each time brought nearer together; the rolls and lifting apron are managed by a man who stands on one side of and a little above the rolls. Mr. Hastings took us through the works and explained the working of the furnaces to us.

another sheet is put on top

The sketch shows the manner in which the rolls are moved. The lower roll is fixed; the upper roll is supported by levers to the end of which are attached weights heavy enough to support the roll. The rolls are brought together by screwing down on the upper roll.

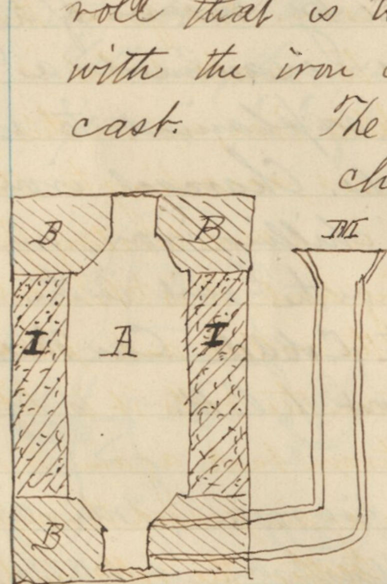


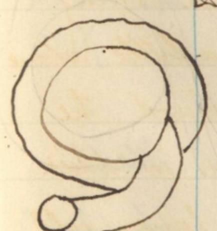
After leaving these works we went to the Diamond State

Iron Company's Works, where we saw a great many furnaces and rolling machines in operation; here they were rolling bar iron and rod iron. After leaving the Diamond State Iron Co's Works we returned on board at about 12.10 P.M.

D. J.

July 29 Went ashore at about 8.30 A.M., and visited the works of J. M. Poole & Co. where we saw a great many chilled rolls, being ~~made~~ finished. The part of the roll that is to be chilled is brought in contact with the iron chill flask when the roll is being cast. The portion of the roll that is to be chilled is brought in contact with the iron flask I. The hot metal is poured in at III and rises up in the flask. The iron portion of the flask, I, is covered with a coating of plumbago to prevent the roll from adhering to the iron flask. The thickness of the iron chill flask is usually about one-half the diameter of the roll.





Plan

After leaving the works of J. M. Poole & Co. we went to the works of Pusey Jones & Co., and went through the Machine shop, Blacksmith shop and Foundry. In the machine shop, the first thing that we saw was a wrecking crane. In the machine shop we saw a large wheel being turned; this wheel had wooden cogs and was to be used on an elevator. At the wharf we saw a large

boiler, which was being hoisted into a schooner; and on the wharf we examined a large cylinder, and condenser, cast in one piece. We next visited the ~~works~~ Lobdell Car Wheel Works; we saw here a pair of very large rolls which were being made for a paper mill near London, England. These rolls were 18 and 14 ins. in diameter, respectively, and 123 ins. long. In these works we saw in operation a very ingenious machine for making horse shoe nails, the iron being heated by means of a gas blast. In the foundry we examined a mould of a car wheel, and had explained to us the method of chilling the wheels. Charcoal iron is the only kind that is used in chilling iron; and in car wheels the part that runs on the rail is the only part chilled. After leaving the Lobdell Car Wheel Works we returned to the ship, at about 1 P.M.

July 30 Went on duty in the after fire room, from 2 to 4 A.M. Cast off from the wharf at Wilmington at 6.50 A.M. Stood watch from 2 to 4 P.M. in the Lower Engine Room.

July 31 Stood watch from 12 o'clock, midnight, to 2 A.M. Made fast to the wharf at Brooklyn Navy Yard, at 12.23 P.M. Was on duty as Officer of the Day from 4 P.M. to 8 P.M.

Aug. 1. Nothing of importance occurred. Remained on board until four o'clock putting in sketches. Went ashore at about 4 o'clock. Crossed Fulton

Ferry to New York; returned on board at 9.30 P.M.

Aug. 2nd. Went ashore to the Brooklyn Navy Yard at about 9 A.M. Saw the large stone dry dock. Examined the boilers intended for the "Juniata"; these boilers were designed by the Bureau of Steam Engineering, and built by the Providence Engine Co.; they are horizontal tubular boilers, and will be furnished with Ryder's patent rocker grate bars. The peculiarity about these boilers is that they have no water bottoms, the water legs resting on cast iron ash-pans. In Fig. 1. B, B, are the water legs. C, C, mud-hole plates. A, furnace door.

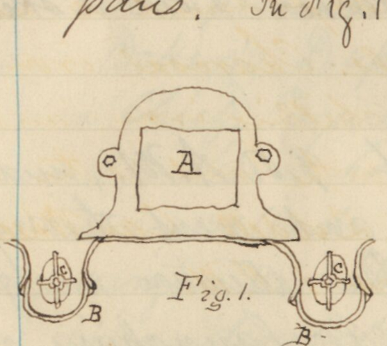


Fig. 1.

Fig. 2 shows the cast iron ash-pans D, D, are the bearings on which the water legs rest. The ash-pans are made in sections, the joints being made at the bearings as shown at E. The boilers are built without water

Fig. 2.

bottoms, because the socket bolts which are used in the water bottoms of boilers are always getting out of repair, and a great deal of sediment collects in the water bottoms, causing their destruction. We examined a very large derrick which is in use at the Yard, for moving heavy weights such as boilers and machinery. We also examined the reversing gear of the hoisting engine attached to the derrick. In the Depart-

ment of Steam Engineering we saw two engines of the "Congress" class, 60" X 36", built for the Java. We also saw the engines of the "Swatara"; designed by the Bureau of Steam Engineering; these engines are 36" X 36", and are duplicates of those in the Steam Building at the Naval Academy. We also saw the torpedo box of the "Spuyten Duyvil", of which there is a model at the Naval Academy. In the pattern shop we saw Ashcroft's Oil Testing Machine. We visited the drawing room, and after examining a great many drawings we took sketches. I took a sketch of a boiler.

good N

Aug 3rd

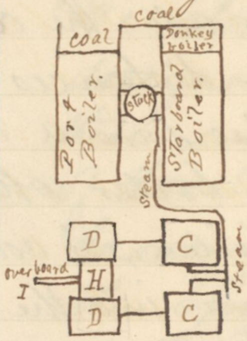
Went ashore at about 9.00 A.M., under charge of P. A. Engineer Nicoll, and went through the Brooklyn Navy Yard. Our attention was first called to the large ways, (for launching ships,) which are a short distance from the wharf at which the "Mayflower" is lying. We also examined the large stone dry dock, and in a large building near the dock we saw the large pumping engine which is used for pumping water out of the dock; the boilers used with this engine have horizontal fire tubes, and vertical tubes in the superheater. In the copper shop we examined a machine for drawing wire, and reducing wire and pipe, the wire and pipe being cold when drawn. We passed through the foundry, and examined three large cupolas, and the manner of charging them.

The blast, before entering the cupolas, passes entirely around them, through a semi-cylindrical pipe; leading from this pipe into the cupola are several holes placed at regular distances apart around each cupola. We also saw a couple of reverberating furnaces. In the boiler shop we examined a large double boiler; it consists of two large cylinders one opening into the other, and being fastened together being bolted to a thick plate, as shown in the margin; this arrangement makes it necessary to attend to but one boiler, as far as the height of water and the steam pressure is concerned. This boiler is called Baker's Duplex boiler. The Baker referred to is now a Chief Engineer, at the Naval Academy. This boiler is to have horizontal fire tubes. The joints are what are called butt and strap joints, as shown in the margin, B.

B

We next examined a very large iron derrick, on the wharf. The engine and gear, which work the derrick, are inside of a small house; the house is moved around with the yard arm of the derrick, and slides on a large base ring, on ball rollers. We next crossed Wallabout Creek to the Cobb dock and went on board of the U.S.S. Brooklyn, and examined her engines and boilers; on each side of the ship is one large boiler, each having seven furnaces, fourteen in all. Just forward of the large boiler on the starboard side is a donkey boiler with one furnace; the corresponding space on the port side is occupied by a coal-

bunker. The engines are direct acting and have jet condensers. The sketch shows the



arrangement of the boilers and engines; C, C, are the cylinders; D, D, are the condensers; H, the hot-well; the pipe I leads overboard from the hot-well.

Before leaving the Brooklyn Mr. Nicoll explained to us the apparatus for lifting the screw out of the water. On the wharf we saw three large 20 in. guns, smooth bore, weighing about 98000 lbs. each. These guns were called Moloch, Satan, and Lucifer. We also saw some large guns with a groove cut on the muzzle and around the bore of the gun; it was intended that iron tubes should be bolted on to the muzzle and extend some distance out from it, to prevent explosion inside of the turrets of monitors, and to keep the smoke from filling the turret; it was found by experiment that this arrangement was not required, and that it was very dangerous. We also saw the Halstead Submarine Boat. We went on board of the torpedo boat Intrepid and examined her engines. The booms to which the torpedoes are fastened are swung out from the side of the ship; there are two booms on each side, one near each mast. The torpedoes are fired by electricity. When we were on board, the Intrepid had temporary bulwarks; these are removed before the ship goes into action. The ship has an armor all around of 5 ins. The pilot

house has an armor of 10 ins., the smoke stack of 5 ins. The torpedoes are exploded from the pilot house. The engines of the Intrepid were built by John Roach & Son. The piston rods run through to the pump.

After leaving the Intrepid we went on board of the "Alarm"; this is a torpedo boat with shafts for the torpedoes arranged to run out on each side, and one from the bow; all under water. The "Alarm" has a Fowler wheel; the engines are compound, with bell crank. There are 26 engines on board of the "Alarm". The large 15 in. gun in the bow is run ~~out~~ and in by steam, and the ammunition is hoisted by steam. The large gun in the bow is smooth bore and fires a 250 lb. shot. The armor on the pilot house is of phosphor-bronze, gun metal 3/8 ins. thick and is used only as a protection against musketry. The ship is plated all around with 7/8 in. iron, except the prow which has a thick armor.

After leaving the "Alarm" we returned on board of the "Mayflower", at about 1.15 P.M.

Good

Aug. 4th. Went ashore at about 9 A.M. and visited the Chrome Steel Works. Chrome ore is found in Maryland, Missouri, and California; that found in California is of a very fine quality. In making Chrome steel the object is to get rid of all the carbon, if possible; instead of mixing carbon with the iron, chromium is mixed with it. In its natural state Chrome ore contains about 60% of pure Chrome ~~ore~~, the remaining 40% consists of silex, oxygen, and aluminum.

The chrome ore is first ground up into a fine powder. In reducing the ore the following is a charge for a crucible;

15 lbs. chrome ore, ground.
3 " carbon, (graphite, or anthracite).
1½ " borax.
15 " charcoal iron.

This will yield about 24 lbs. of ferro-chromium, or shotted compound. The ore is an oxide and the carbon takes off the oxygen. The 1½ lbs. of borax fluxes the silex, and aluminum. The ferro-chromium is poured from the crucibles, before it is allowed to cool, and allowed to drop some distance through the air into cold water; this gives it an appearance like that of shot; it is given this form because it is more easily work in that form. The iron used in making this steel is brought to the steel works in the shape of "blooms", it is then heated in furnaces (the furnaces used gas furnaces) and rolled into bars about 2½ ins. x ¾"; these bars are cut up into short pieces before being put in the crucibles with the ferro-chromium. In 100 lbs. of chrome steel there are from 1½ lbs. to 4 lbs of ferro-chromium.

In making the ferro-chromium, the chromium is mixed with iron to reduce the melting temperature, because to melt chromium requires a very high temperature.

When the compound called chrome steel is sufficiently melted it is poured from the crucibles into iron flasks which have been

smoked, in order to prevent the steel from adhering to the flask. The steel is taken from the flask in the form of an ingot, this ingot is heated and hammered once or twice to make the metal more dense.

The crucibles, in which the ferro-chromium and iron are melted, are made of 90% plumbago and 10% fire clay; these crucibles will stand only from two to four heats before they are destroyed by the heat.

Chrome steel is not injured by the heat unless brought in contact with cold water, when the metal is very hot.

We saw several experiments tried with Chrome steel; a bar was brought to a welding heat and one end of it split in two by the blacksmith and welded together again; the same piece was then made into a fine cold chisel.

Another bar was taken and a piece broken from the end of it to show the very fine grain of the steel, this piece was then heated to a white heat and plunged into cold water, after this a piece was broken from the end of the bar showing a very large grain and a split on one side of the bar, this split was caused by the water; the same piece was then heated to a welding heat and cooled in the water, this caused it to return to its original condition, and show a very fine grain. We also saw several bars twisted cold by hand. We saw a piece of 1/4 in. iron with 1/2 in. holes punched through

it, with a punch made of chrome steel; and we examined some prison bars made of iron and chrome steel, and a piece of plate intended for burglar proof safes; this plate consists of alternate layers of iron and chrome steel welded together into one plate. After leaving the Steel Works we returned on board the "Mayflower" at about 1 P.M.

Aug 5th. Went ashore on liberty at about 10.30 A.M., visited Central Park, Fifth Avenue Theatre and a few other places. Returned on board at 9.25 P.M.

Aug 6th. Remained on board all morning. Was on duty as Officer of the Day from 12 M. to 4 P.M. Went ashore at about 4.30 P.M., and visited Prospect Park; returned on board at 7.15, P.M.

Aug 7th At about 8 A.M. the "Mayflower" was moved, by tug boat, from the wharf at which she was lying, and towed some distance farther up, alongside of a coal barge, where she commenced taking in coal.

The Cadets embarked on the tug boat mentioned, and were taken to the Delamater Iron Works in New York.

We saw here in one of the shops a caloric engine, which is intended to work a fog signal; we also saw a very large casting for a sugar evaporating pan, this casting was 16 ft.

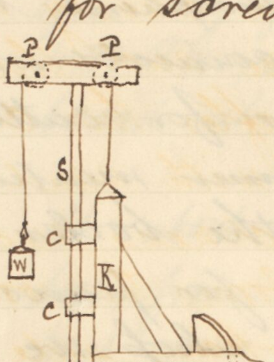
in diameter. We saw several other large castings intended for sugar mills; one very large pan was being turned on a lathe with a peculiar bearing, the large plate on which the work rested revolved in a V-shaped groove, the work was not fastened to the shaft in the centre, but revolved about it. In the same shop we saw a blade of Baird's propellor. Just outside of the shop we saw a large, spherical, iron hub, a part of one of Griffiths propellors, it was arranged so as the blades could be bolted on the hub. We also saw a propellor designed by Mr. Stimers, this propellor had a very large spherical hub and very short blades.

In the blacksmiths shop we saw several steam hammers, and one atmospheric hammer which was worked by a belt connected with the shafting; we also saw shears for cutting round iron. The atmospheric hammer mentioned was patented by Hotchkiss. In the boiler shop we saw a large punch, for punching boiler iron; in the same shop we saw the boilers which are being built for the U. S. S. "Colorado"; these boilers are like the boilers of the "Juniata", that we saw at the Navy Yard; they have no water bottoms.

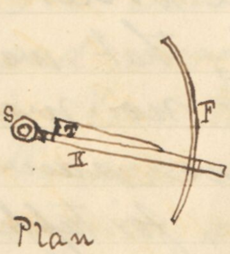
In the machine shop we saw a very ingenious tapping machine, for tapping pipes. This machine can tap five T joints at once or cut fifteen different threads at the same time; the

threads are cut in the first half of one revolution of the machine, in the other half of the revolution the tap is withdrawn from the pipe; this is caused by the pinion, which works the tap, working on a rack below it for one-half of the revolution, and on a rack above it, during the other half of the revolution. We also saw in operation a caloric engine of the same kind as the one we saw for the fog signal, and another of a different kind, patented by Ericsson. We examined a wooden model of a valve motion intended to do away with link. I made a sketch of this model.

We visited the foundry where Mr. Nicoll explained to us the manner of making molds for screw propellers.



Elevation



Plan

T, is a right triangle made of wood and bent so that the base, when placed on the ground, will coincide with the circumference of the circle required, the triangle being made with the required pitch. The sweep K is a right triangle made of three pieces of inch board, it is balanced by the weight W, and works up and down and around the shaft S, on the slides C, C; on one side of, and fair with the bottom of the sweep is a piece of wood called the thickness piece, this piece is made of the

required shape. Inside of the bent triangle F, is built up with brick work to within three or four inches of the top of the triangle, and above the brick work the sand used in moulding is packed up to a level with the top of the triangle. A pattern of the hub is placed around the shaft S near the bottom, and the sweep K and thickness piece T work around this hub. When the sand is ready for forming the mould, the sweep K is brought to the bottom of the triangle, and revolved around the shaft S, the sweep always touching the bent triangle which acts as a guide and gives it an upward motion; this is first done with the thickness piece T fastened to the sweep; the thickness piece makes a cavity in the sand of the required form and thickness of the propellor blade; after this cavity has been formed it is filled in with sand, and the sweep, without the thickness piece, is again passed over the sand, this forms the working side of the blade. The working side is the after side of the blade when it is in position on the ship, it is the side that presses on the water in going ahead, and it has a true helicoidal surface. After the sweep has been passed over and the cavity formed by the thickness piece, the edges are finished off with a knife and trowel, and the cavity finished with a thin wash of powdered

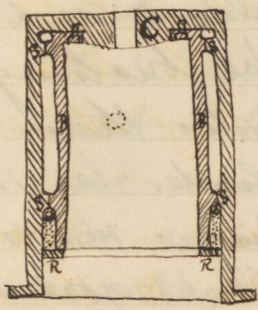
charcoal and clay-water before being filled in with sand. After the working side has been formed, a cope is placed on top, and sand packed in it from above; the whole thing is then placed in an oven and baked. After having this explained to us, we separated to take sketches, and after making the sketches required we assembled in the drawing room, where Mr. Nicoll examined the sketches, after which we went on board of the tug and returned to the "Mayflower" at about 3 P.M.

Having finished coaling, the "Mayflower" was towed back to the wharf at about 6 P.M.

good X-

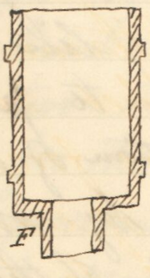
Aug. 8th. At 9 A.M. the cadets went on board of the tug "Rocket", and were taken to the Morgan Iron Works, John Roach & Son, proprietors. The first thing that we noticed was a Hirsche's patent propeller blade, which was outside of the building. In the machine shop we noticed two large cylinders which were being made for the "Miantonomah", one of them, the high-pressure cylinder had just been bored out preparatory to putting in the bushing; the low pressure cylinder had the bushing or lining already fitted in, and was having the bushing bored out. These cylinders are cast with one head on, the head through which the piston rod works; these heads have several round holes in them

so as to allow the core to be removed after casting; in finishing the cylinders these small holes in the heads are bored out and a thread cut on the inside of them, they are then fitted with screw plugs, and made water tight. These cylinders are first tested with water pressure, every part being made water tight, and water pumped into the cylinder until the gauge shows a pressure of 100 lbs. to the square inch. The cylinders are then tested with steam, the pressure being from 60 to 70 lbs.



After the cylinder C has been cast it is bored out leaving the shoulders S, S, projecting; the bushing B is turned up with corresponding shoulders projecting on the outside; this bushing is forced into the cylinder by ~~hydraulic~~ screw pressure, the shoulders on the bushing fitting those on the inside of the cylinder; there is left a space between the bushing and cylinder which is used as a steam jacket, live steam from the boilers being allowed to pass into this space; there is a hole in the bottom of the cylinder and connected with the drain pipe by which the steam jacket is drained. One end of the bushing has a flange cast on it, this flange is fastened by means of countersunk screws to the outside cylinder. The space between the bushing and the cylinder at the other end is packed by placing a ~~coil~~ turn of wire rope in

it. The wire rope is about 1/8 in. larger than the space, and it is cut so that one length will exactly fit around the bushing because if it is just a little too long it buckles up and cannot be hammered into its place; the wire rope is hammered down with a caulking iron. Above the wire rope and filling the space flush with the end of the bushing is packed a cement made of iron borings mixed with sal ammoniac and salt water; over the end of the bushing and covering the packing an iron ring, R, is placed and bolted to the end of the bushing. The bushing is made of very hard iron much harder than the iron of which the outside cylinder is made. The iron of which the bushing is made is one-third No. 1 charcoal pig, one-third good machinery scrap, one-third No. 4 pig, very hard; No. 1. is rather soft, No. 4, very hard.



In casting the bushing for a cylinder, the mould is placed so that the end with the flange on it is upward; the mould is made with an extra flange F, as shown in the sketch; this is to allow the bad iron to run up into the flange F, which is cut off afterwards.

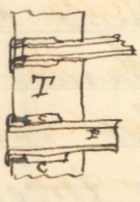
The joint on the back of the bushing, where the flange is, is made with red and white lead, two parts of red lead and one of white;

if the white lead is not soft enough a small quantity of linseed oil is mixed with it.
We saw several piston rods; on the compound engines each low pressure engine has two piston rods and each high pressure engine has one. We also saw several composition pistons, and a valve face made of hard cast iron in which the ports were being cut; this valve face is fastened on by means of countersunk screws to allow the valve to slide. We saw a rough thrust-bearing, and a large crank being planed up, this crank had two slots cut in it on one end, one on each side, the slots were shaped like a dovetail, and were for the purpose of fastening on the counterbalance. We saw a very large casting of a cylinder for the Steamer "Massachusetts"; this cylinder was 90 ins. in diameter and 14 ft. stroke. We also saw a very large working beam and two castings containing poppet valves, all for the Steamer "Massachusetts." The seats of the poppet valves are made of composition and are forced into place, the joint being made of lead, and the bottom of the seat allowed to project down about 1/4 in. so as to allow it to be hammered over the edge of the iron.

We visited the foundry and examined a large condenser mould, which was explained to us by Mr. Jones. This mould

was made of loam. Loam is used only in making large castings; it consists of five parts of fine sand, and one part of moulding sand, it has also a small quantity of horse manure mixed with it, the whole is mixed with clay water; the horse manure is used to make it porous. The loam moulds are always built up with brick. Moulding sand is used only in making small castings, and the moulds made with it are never bricked up.

After leaving the foundry we visited the drawing room, and examined several drawings; we also had shown to us by Mr. Nicoll a specimen of Allen's patent condenser packing, with paper gromets; this is the kind of packing that is to be used on the "Trenton", only that the gromets will be of wood. The packing is as shown in the sketch, c,c,



are the gromets, T is the tube sheet, P is the condenser tube. The ends of the tubes project outside of the tube sheet and have small slits cut in them so as to allow them to be bent an hammered over. In the drawing room we also saw a model of a swinging propeller. We also saw a <u>steam and vacuum</u> gauge intended for the "Trenton". We left the drawing room at about one o'clock and returned on the tug to the "Mayflower."

very good

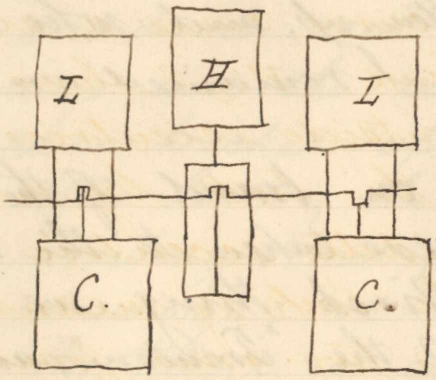
[The cadets went on board of the Tug Rocket]

Aug. 9th. Remained on board nearly all day putting in sketches. Permission was granted to the cadets to go on shore at about 11 A.M. to see the "Vandalia" put in the dry dock.
Liberty was granted in the afternoon to all the cadets who had their sketch-books and journals written up, and who were not quarantined. I remained on board.

Aug. 10th. The cadets went on board of the tug "Rocket" at 9 A.M. and were taken to the Morgan Iron Works. The first thing we did was to go on board of the "Trenton", and examine the engines and boilers. There are eight cylindrical boilers, four on each side; each boiler has three furnaces; the man holes are of a peculiar shape in order to have them large enough; see sketch in margin.

The steam pipe passes through the uptake, this causes the steam to be superheated; some of the fire tubes are larger than others and have threads cut on the ends with nuts screwed on, these tubes act as braces. The smoke pipe is of the telescope kind and has a ventilator passing up through it from the fire-room; the ventilator is not telescopic.
The engines are three cylinder, back-

acting, continuous expansion engines. There are two low-pressure and one high-pressure cylinders; the high-pressure cylinder has a Wabash cut-off valve, the low-pressure cylinders have no cut-off valves. The low pressure cylinders have double valves, that is the valves are made in two parts. In the sketch



H is the high pressure cylinder; L, L, the low-pressure cylinders; C, C, the condensers.

The high pressure cylinder is 57 ins. in diameter and 48 ins. stroke. The low pressure cylinders are 78 ins. in diameter and 48 ins. stroke. These engines are intended to develop 3500 horse power.

The valve on the forward, low-pressure engine, and the main ~~slide~~ valve on the high-pressure engine are worked by six eccentrics placed forward of the engines; the valve on the low pressure cylinder being worked by a sleeve fitted over the shaft which works the valve on the high pressure cylinder. The cut-off valve on the high pressure cylinder and the slide valve on the low pressure cylinder aft are worked by four eccentrics placed aft of the engines;

three of the four eccentrics work the slide valve of the low-pressure cylinder, the fourth eccentric works the cut-off valve on the high-pressure cylinder.

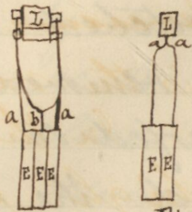


Fig. 2. Fig. 1.

The object in using three eccentrics is to prevent the curve in the eccentric rod where it takes hold of the link, as shown in Fig. 1 at a; this curve causes a side motion of the link. Fig. 2 shows three eccentrics; the two outside eccentrics connect with the bottom of the link by means of the rods a, a; the middle eccentric connects with the top of the link by means of the bar b which has two arms forming a U-shaped curve.

The circulating pumps on the "Trenton" are altogether independent of the main engines; they are two centrifugal pumps and are worked by two separate engines. We examined the thrust bearing, and the strainers for the bilge pumps; the thrust bearing is braced fore and aft by means of rods fastened to the keel. After leaving the "Trenton" we went into the forging shop of the Morgan Iron Works where we saw a small shaft being heated, after which we went to the drawing room. The cadets remained in the drawing room sketching until about 2 P.M., when they returned to

the forging shop, on the way down to the wharf. In the forging shop we saw the workmen scarfing on a small piece of iron to the shaft which we had seen before. The shaft was first heated, then put under a steam hammer and notched to receive the piece; the shaft was then removed and the piece which was to be scarfed on was placed under the hammer, cold, and the shaft placed on it so that the notch fitted over the piece, they were then hammered sufficiently to fastened them together, when they were put in the furnace to be heated in order to finish the welding. Just above the furnace was placed a cylindrical boiler used in running the steam hammer; it received its heat altogether from the blast furnace below.

After leaving the forging shop we returned to the wharf, but as the tug had not returned, we ~~embarked~~ went in the steam launch, arriving on board the Mayflower at about 2.30 P.M.

Aug. 11th. The cadets went on the tug "Rocket", to the Morgan Iron Works, arriving there at about 9 A.M. We went on board of the Steamship Crescent City, of New Orleans, and examined her engines. The engine is vertical and direct acting; the cranks on the propeller shaft are counterbalanced. The general arrangement of the machinery is very

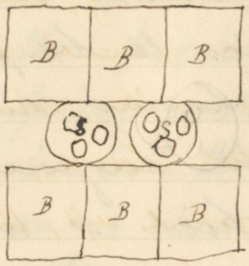
much like that on the Mayflower. The reversing gear is peculiarly arranged; the hook motion being used instead of the link; one of the eccentrics is connected directly with the valve stem, the other is connected by means of levers in such a manner as to allow the eccentrics to be placed close together instead of having one 90° in advance of the other. The engine has a Meyer cut-off valve which is worked by a separate eccentric.

After leaving the "Crescent City" we examined a large cylinder with poppet valves, and a large condenser that were lying on the wharf; the only things to be noticed about these were the manner of fastening the poppet valve seats, and of securing the condenser tubes.

In the forging shop we saw the workmen forging the frame of a large rudder; the frame is to be of wrought iron covered with boiler iron.

In the boiler shop we saw six large cylindrical boilers, 12 ft. 8 ins. in diameter, which were being built for the new Sound Steamer "Massachusetts"; these boilers will be placed three on each side, the two middle boilers are made of steel from Cleveland O. and Nashville Tenn. There will be two large super-heaters

one a little larger than the other, the large is made of steel; the smaller one superheats the steam from two of the boilers; and the large one super-heats the steam from the other four.



In the sketch, the boilers are marked B, the super-heaters S. Each of the boilers has three furnaces; all of the tubes are made of iron.

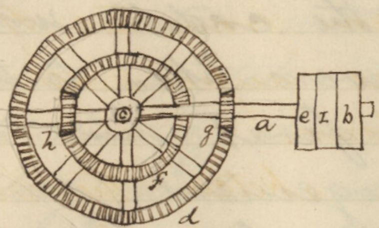
We also saw a very large riveting machine for riveting plates 1 1/8 ins. thick; this machine weighs 28 tons, and is capable of exerting a pressure of 80000 lbs. We also saw a machine punching holes in a circular angle iron.

In the machine shop we saw the workmen keying up the pins in the large working beam for the "Massachusetts".

When we visited the Morgan Iron Works on the 8th, mention was made of the manner in which the bushing for cylinders is cast, with a flange on one end; on the 8th we saw a bushing with the flange on, and to-day we saw the same one with the flange cut off; but the flange in this case did not answer the purpose altogether, as the end of the bushing had a great many small holes in it and one or two large ones. For sketch of bushing see page 46.

In the machine shop we saw a large ver-

tical planer; the tool is worked by means of gearing worked by the shaft c, which passes through the large double gear wheel fastened to one end of it; this double wheel is one casting; the two pulleys



e and b are fixed to the shaft a, the middle pulley I is loose on the shaft. When the belt is on b it works the tool down, and when the belt is on e the tool is worked up; the pinion f working in the gear d, and the pinion h working in the inside gear g.

After leaving the shops we went on board of the "Trenton" but did not see any thing that we had not seen the day before.

At about 1 P.M. we returned on the tug to the "Mayflower."

Aug. 12th. All of the cadets who had their sketch books and journals written up to date, and were not quarantined on account of any thing else, were granted liberty on shore until 9.30 P.M.

I remained on board all day putting in sketches.

Aug. 13th. Nothing of importance occurred. The cadets were allowed liberty on shore from 9.30 A.M. un-

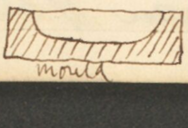
til 9.30 P.M. I remained on board all day.

Aug. 14. At about 9.00 A.M., the cadets went on the tug "Rocket", and were taken to the Quintard Iron Works. The first thing that we saw was an arrangement for working a damper in the chimney of a stationary boiler; the working of this arrangement is the same as that of a safety valve, only that it is arranged so as to raise the valve at a less pressure than is required to raise the safety valve.

In the machine shop we saw a large boring mill for boring cylinders; it consists of a large vertical shaft with gearing overhead. We saw a slotting machine cutting a bearing for a pillow block. We saw also a small connecting rod being turned up.

In the boiler shop we saw several large boilers which were being built for the "Alaska" and class; these boilers have five furnaces each and have no water bottoms; we also examined the bracing in these boilers, the tubes not having been put in yet. We saw a riveting machine with which the workmen were riveting a small boiler. In one of the shops we saw the workmen beating out the ends of flues ~~tubes~~; the ~~tubes~~ flues were about 15 ins. in diameter and closed at one end. The plate which forms the end is heated and


End of tube


mould

placed on an iron block, which is hollowed out ~~with~~ to the required curve; the plate is then beaten with large wooden hammers until it takes the form of the mould; a section of the mould is shown in the sketch along with a section of one end of the pipe.

In the forging shop we saw the workmen forging the bearing, on the end of a small shaft, with a steam hammer; when the forging was nearly finished water was sprinkled on the iron in the places that the hammer struck, this was done to crack off the scale.

In the pattern shop we examined and had explained to us the patterns of a cylinder intended for the Albany water works; the method of forming the mould was also explained to us. In making the patterns, the pattern maker has to make allowance for the shrinkage of the iron; when the mould is made of loam it is necessary to to add 1/16 in. to every foot to allow for shrinkage; when the mould is made of green sand 1/10 in. is added to the pattern. Hard iron shrinks more than soft iron.

After leaving the Quintard Works we crossed the ferry to Greenpoint, and marched to the Continental Iron Works, T. F. Rowland proprietor; we arrived there at 11.40 A.M. We first visited the foundry where the

workmen were engaged in making the moulds for a hydraulic press, 16 ins. in diameter and 24 ins. stroke, intended to exert a pressure of 1000 lbs. to the square inch; this machine is for pressing out the shells of torpedoes; the torpedoes are spherical in shape; the shells are pressed out in the shape of hemi-spheres and welded together. These torpedoes were formerly made by the drop process; the hydraulic machine was invented and patented by Mr. Rowland. We also saw a large hydraulic ~~ram~~ lift for hoisting coal, the only force used being the pressure of water from the city water works. We passed through a shop which is used for the purpose of cleaning the rough castings in. In one of the shops workmen were engaged in straightening iron plates which are used in making gas holders; a great deal of work was being done for gas works. In another shop we saw a punching machine with sixty punches, at the time that we saw it, it was being used for punching holes in the plates that we saw the workmen straightening; these plates are about 1/16 in. in thickness; the punches on the machine were placed about one inch apart; all of the sixty holes were punched at one time. In the same shop we saw a machine for planing the edges of

iron plates; the plates are placed one on top of the other and clamped together, the edges of each pile of plates being planed off all at the same time. We saw six large cylindrical boilers intended for the "Monadnock"; these boilers have three furnaces each; the furnaces are welded, the joints not being riveted; the boilers are 12 ft. in diameter and 11 ft. long; the riveting on the shells of the boilers is what is known as square riveting. The total grate surface in the six boilers is 360 square ft.; the total heating surface is 8226 sqr. ft. We saw two very large furnaces for heating bar and plate iron; these furnaces are for the same purpose as those that we saw at the ship yard of Wm. Cramp & Sons, in Philadelphia; the furnace for the bar iron is large enough to heat a bar 50 ft. long. In the same shop that we saw the furnaces, we saw one of the hemi-spheres used in making the torpedoes; we also saw one of the old style of machines for making the hemi-spheres, by the drop process; a pressure of 50 lbs. to the square inch is put on the globes of the torpedoes after welding them.

We went down to the wharf where we saw a model of the bottom of the "Monarch", about 20 ft. square, in the water; the "Monarch" is an English iron clad; when it came to this country Mr. Rowland got copies of the detail drawings, from which he construct

the model. The model is used for the purpose of testing torpedoes; by the effect produced on the model it can be seen what would be required to blow up the ship itself.

We also saw a composite steam launch in course of construction. We examined the boiler and engines of this launch; the boiler had been tested with a water pressure of 200 lbs. to the square inch and a steam pressure of 150 lbs. to the square inch; there will be two engines 8 ins. in diameter and 6 ins. stroke. It is intended that this launch will run 20 miles per hour; the engines will have 600 H.P., and make 500 revolutions with a pressure of 120 ~~60~~ lbs. of steam. The launch is called composite because it is made of wood and iron; the frame is made of iron, and the keel and planking or outside skin are made of wood.

In the machine shop we saw an arrangement for raising the turrets of monitors, it consists of four hydraulic rams, by means of which the turret can be raised in one-half ~~four or five~~ minutes, while it would take from one-half to three quarters of an hour to raise it in the old way by means of the wedge. When the hydraulic ram was first tried, a single cylinder was used and this was placed directly under the shaft on which the turret revolves; this arrangement would not work, because

when the 20-inch gun, in the turret, was fired the shock caused the ram to be broken. As it is arranged now, after the turret has been raised the wedge is placed under the shaft and the shock does no harm; these machines were designed by Mr. Rowland, and all of them that are used are made by the Continental Iron Works. After leaving the machine shop we saw in the yard a large condenser for a gas works. We visited the drawing room where we examined several drawings, and had explained to us by Mr. Rowland the machine for making torpedo shells.

The first "Monitor" that was ever built was built at the Continental Iron Works. We left there at about 2.15 P.M., and returned by the street cars to the navy yard. Was on duty all day as "Mate of the Steerage". Spent the afternoon in writing up journal. good

Aug. 15 All of the cadets went ashore at about 9.00 A.M., and visited the Ridgewood Engine House of the Brooklyn Water Works; we arrived there at about 11.10 A.M.

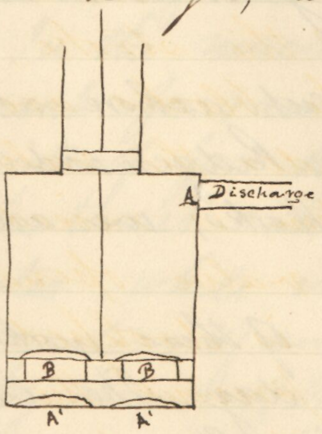
The conduit capacity of these works is (40,000,000) forty million gallons per day. The large conduit goes as far as Jamaica Stream, a distance of 4 3/4 miles; for that distance the fall is 6 in. to the mile. Beyond the 4 3/4 miles, the conduit is extended 7 1/2 miles, and takes water from

the Brookfield, Clear, Valley, Rockville, and Hempstead Streams; the conduit extension has a fall of 6⅓ ins. per mile.

A storaige reservoir is being built near the Hempstead Stream, for the purpose of storing the water furnished by that stream in the rainy season.

Good

In the engine house there are three very large pumping engines; the piston stroke is ten feet, and the pump stroke is the same. The engines are numbered 1, 2, and 3. The steam cylinder of No. 1 is 80 ins. in diameter; the steam cylinders of Nos. 2, and 3 are 85 ins. in diameter. Nos. 1, and 2 have each two single acting, lifting pumps, 36 ins. in diameter. No. 3 has but one pump 50½ ins. in diameter; this pump is single acting on the induction, and double acting on the discharge; as shown in the sketch it



has two cylinders, one large one with a smaller one above it; both pistons are on the same rod; the piston of the small cylinder has no valves, therefore, no water is allowed to pass above the piston of the small cylinder; the large cylinder has valves in the bottom for the induction, and the large piston has valves which are closed when it is going up

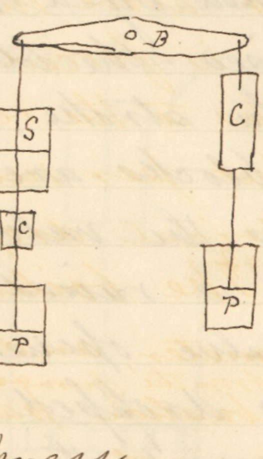
When the pistons rise, the valves in the large cylinder are opened, and those in the large piston are closed. The water then comes in through A'A'. When the pistons come down the valves B,B, open and A',A', close; the water then rises above the large piston, and the large cylinder is filled with water. When the pistons rise again the water above the large piston is discharged through A.

and open when it is coming down; the water is forced out of the discharge pipe A.

The water is also discharged when the pistons go down; it is drawn in only on the up stroke.

All of the engines have working beams 30 ft. long; they also have double poppet, steam and exhaust valves. Engines Nos. 1 and 3 have large fly wheels, 26 ft. in diameter The middle engine, N. 2 has no crank, nor eccentric; the valves are worked by means of a water cylinder with a pressure of 60 lbs. to the square inch. Nos. 1 and 3 have no eccentrics; the valves are worked by beveled gearing; the cut-off arrangement is the same as Sickles' cut-off with a slightly different arrangement; the time at which it would cut-off is regulated by means of a right and left-handed screw which draws together or moves farther apart two sliding blocks which are worked by a rock shaft; another rock shaft raises the blocks at the required part of the stroke, and lets them fall again; the blocks are raised when they are under the valve stem so that the valve stem is raised at the same time, and the valve opened; when the sliding block is dropped the valve also drops, and to prevent the valve from coming down on its seat with too much force, the valve stem is connected with a piston working in a cylinder partly filled with oil; this cylinder is called

a dash pot; the oil acts as a cushions and prevents a jar. By turning the right and left-handed screw the sliding blocks are kept a longer or shorter time under the valve stem. Nos. 1 and 2 have each a water pump on one end of the working beam, and a counter balance on the piston rod of the pump, at the same end; the counter-balance on number 2 is much larger than that on No. 1, and takes the place of the fly wheel, and is balanced by means of another counter-balance at the other end of the beam. Nos. 1 and 2 have water pumps on the same end of the beam that the steam cylinders are on; the pumps are placed under the steam cylinders and are worked by the piston rods of the steam cylinders. As shown in the sketch B is the working beam; C, C, the counter-balances; P, P, the pumps; and S the steam cylinder.



The working beams have no guides, the rods being worked by parallel motion.

The steam cylinders have oil-feeders, worked by steam pressure, for forcing oil into the cylinders. These engines have about 475 horse power each, that is at the rate at which they are worked. They do not run very fast. Each of the three engines pumps 1050 gals.

per stroke, and make eleven strokes per minute, so that the three engines have a pumping capacity of 34650 gals. per minute; only two of the three engines are in operation at one time unless in case of an emergency, as was the case some time ago, when all three were working on account of a break in one of the large pipes. The engines work day and night. Connected with each of the pumps is a wrought iron discharge pipe 40 ins in diameter, and a cast iron discharge pipe 6 ft. in diameter and having in it (16) sixteen rubber check valves about 14 ins. in diameter; the cast iron pipe is made larger than the other on account of the valves, because the frame on which the valves rest occupies some space. The surface of the water in the reservoir is 170 feet above the ~~bottom of the pumps~~ surface of water in the well. The water is forced through the pipes from the pumps to the reservoir at the rate of about 220 feet per minute.

There are three cylindrical drop flue boilers for each of the engines. The boilers for Nos. 1 & 2 Nos. 1 and 2 are 8 ft. in diameter, and 30 feet long. The products of combustion pass from the furnace to the back connection through four flues, 20 ins. in diameter, then drop and ~~pass forward~~ return through 16 flues 8 ins. in diameter, they then drop again and pass back under the shell of the boiler and up through the ~~uptake~~ chimney. Each boiler has two furnaces three feet

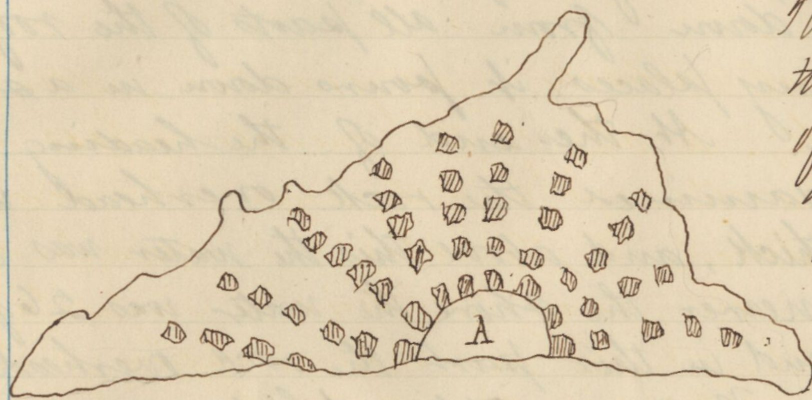
wide and six feet long. No. 3 engine has five boilers of the same kind as Nos. 1 and 2 but smaller; they are seven feet in diameter and twenty-four feet long; the flues are smaller in proportion. After leaving the water works we returned on board of the "Mayflower" where we arrived at about 3.10 P.M.

Aug. 16 General liberty was granted, after one o'clock, to all of the cadets whose journals were written up to date, and who were not quarantined to the ship. I remained on board all day; nothing of importance occurred. I was on duty as Officer of the Day, from 10 P.M. to 12 midnight.

Aug. 17. At about 9 A.M. the cadets went on the tug "Rocket" and were taken to the wharf at the foot of Fulton St. New York city where we embarked on the Steamer "Shady Side", of the Harlem line, and were taken to Halletts Point L. I.; this is the place at which the excavations have been made in the rock, for the purpose of making a better channel through the pass known as Hell Gate. It had been raining hard all morning, and it continued to do so while we were at Hell Gate, and until we returned on board of the "Mayflower". All of the cadets wore rain coats and cap covers, and those who had them wore overshoes;

the uniform is mentioned, because it was understood that this uniform would have been worn if the day had been fine, on account of the water that leaks through the rock into the excavated part underneath.

Before going below to examine the excavations we were shown a drawing of them.



The sketch shows the general plan of the excavations; the hatched parts represent the columns which remain to support the roof or upper part of the rock.

The area of the excavation is about acres; about cubic yards of rock have been removed. The cracks overhead in the rock are stopped with wooden wedges. This work was begun in 1869 and will be blown up about Oct. 1876. The space A in the sketch is a large shaft in the rock; all of the headings lead from this as a centre. We descended into the space A, and being provided with a dozen lamps, went into heading No. 7 which we examined to the end, about 240 ft. from the entrance. All of the columns and the roof have holes drilled in them; these holes are inclined

from a vertical line at an angle of 45°; they are 3 ins. in diameter at the entrance and 2 ins. at the end. Nearly all of these holes are stopped up with wooden plugs on account of the water leaking through. Some of the galleries are filled with water to a depth of 3 ft. or more. The water drips down from all parts of the roof and in many places it pours down in a steady stream. At the end of the heading that we examined the rock overhead was 10 ft. thick, and above this the water was 30 feet deep; nearer the shore the water was 26 feet deep, and in this part the rock overhead in heading No. 7 was 7 feet thick.

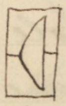
The leakage in the excavations is about 700 gallons per minute; the water is pumped out over the coffer dam. A coffer dam is built around the space A, on the top of the rock; it is built in the shape of an arch, and is made fast to the rock by iron rods which fit in holes drilled in the rock; the coffer dam is sunk by being weighted with rock and dirt. The bottom of the arch formed by the coffer dam is supported against the shore, this is in order to resist the pressure of water from the outside.

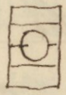
There are three engines for pumping out the excavations; when we were there, there was but one in operation; the

cylinders are 12 ins. in diameter and 3 ft. stroke.
Near the pumps there is a large well, lower than any other part of the works, it is 54 feet below mean low water; this well drains the excavations, and the water is pumped from the well over the cofferdam into the river.

DJ

Aug. 18. The cadets went ashore at 9 A.M., and visited Benton's Steam & Gas Pipe Works; At these works we saw the method of making pipes. The flat sheets of iron, of the proper length and width, are first put in a furnace and heated; when they are sufficiently heated they are taken out and passed through a die which rests on a frame, or table, in front of the furnace. For the pipes that we first saw being made, 1¼ ins. inside diameter, the iron was about 3/16 ins. thick, cut into plates about 5 ins. wide and 15 ft. long.


A


B

The plates are taken out of the furnace when they are red-hot, and put in the die, through the end shown at A, in the sketch. (For full description and sketch of die, see sketch book). The plates by being drawn through the die are made almost but not quite, round. The pipes after being passed through the die, as described above, are put in another furnace and slightly heated, they are then put in a third furnace and heated to a white heat when they are drawn through a pair of tongs held at the door of the furnace, this draws the edges together; they are then put in another furnace, and drawn through the tongs again and the edges welded together; without any further heating they are drawn through another pair of tongs and made of the required size. After passing through the tongs they

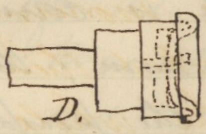
are made to pass under a large flat roller and rolled, in order to straighten them; when they are being rolled water is allowed to drip on them; this is for the purpose of breaking the scale and making them smooth.

The whole of the tube is not worked at the same time; about one-third is left not quite formed; the work of forming the tubes from the plates is begun in the morning, and the parts that are not worked then are finished in the after-noon; the whole length of the tube is not finished at one time because it is necessary to leave a part by which to handle it. In drawing the tubes through tongs, they are caught at one end by a pair of tongs made fast to an endless chain, this draws them through the die and the forming and welding tongs.

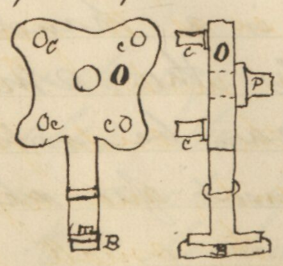
After the tubes have been rolled, the threads are cut on the ends of them, and they are then tested. We examined a testing machine, and saw some of the pipes being tested.

The testing machine consists of a reservoir into which water is pumped under a piston working in the reservoir, the piston being weighted heavily above, so as to give a pressure of 300 lbs. to the square inch. The tube is placed on a table, and the ends fitted over a small pipe at one end, and against a rubber seat at the other; the small pipe, over

which the tube fits at one end, is connected with the reservoir, and by turning a small wheel the valve is opened that admits water to the tube from the reservoir; the tubes are made water tight at the ends, when being tested, by means of pieces of leather placed over the seat against which the ends rest; see sketch D.

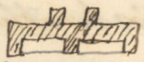


After leaving the tube works we went to the Niagara Steam Pumps Works. The first thing that we saw was a back-acting pumping engine that had been just put together. It is arranged so that the pump can be disconnected from the engine and the engine used for other purposes. This engine was built to be used in a cooling tower, on a sugar plantation, in Cuba. The steam cylinder is 18 ins. in diameter and 18 ins. stroke; the pump is 12 ins. in diameter; with a pressure of 60 lbs. of steam to the square inch, and the piston travelling at the rate of 150 ft. per minute the pump discharges 1200 gallons per minute. The piston rod and all the working parts of the pump are made of composition.



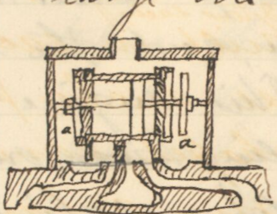
The sketch shows the arrangement of the crosshead and side rods. O is the cross-head, P, the piston rod, and C, C, C, C, the side rods; B is the brass which works on

the fixed guide below. We examined, and had explained to us, the valves which are used on the Niagara direct-acting pumps; on each engine, there are two separate valves in the steam chest; one of the valves, the smaller one, is a common D valve, as shown



Small valve

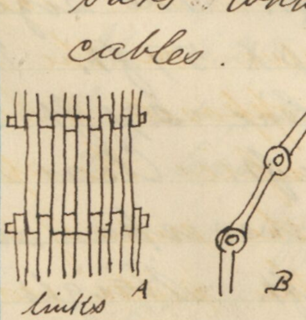
in the sketch, with a partition in the middle of it; this valve receives its motion from a lever which is connected with the cross head by means of an arm; the cross-head is fitted on the piston for the purpose of working this valve. The engine works the small valve only, and the small valve works the large one by admitting steam to it.



Large Valve

As shown by the sketch the large valve consists of a cylinder with a piston inside of it; steam is admitted to the cylinder, and as the piston and rod are fixed to the steam chest, the cylinder or valve moves. The steam exhausts from the large valve on the side of the steam chest which is opposite to the small valve. The steam which occupies the space between the discs a, a, and the ends of the valve, acts as a cushion when the piston reaches the end of its stroke. There is a handle attached to the lever which works the small valve so that it (the small valve) can be worked by hand. There is also an arrangement for shortening the stroke.

After leaving the Niagara Pump Works, we went to the Brooklyn anchorage of the East River Bridge, and went to the top where we saw several large wooden drums for the purpose of paying out the wire; there are, at present, two wires, about 7/8 in. in thickness, stretched across the river from anchorage to anchorage and passing over the tops of the main piers. The anchorages are two stone piers, one on each side of the river, and some distance back from the main piers; they are 129 x 119 ft. at the base, and 117 x 104 ft. at the top; they are 89½ ft. above high water mark, at the front edge. There are four anchor plates, weighing 23 tons each, built in each anchorage, in the foundations; these anchor plates in their general form are shaped something like a wheel without a rim or band. Fastened to the anchor plates are the links or bars which take the strain of the four main cables.



Sketch A shows a plan of the links; and B shows a side elevation. The links form a chain built in the masonry; from the anchor plates to the top of the anchorage the chain forms ~~an~~ arc of a circle; there are about nine links in a row, in each of the chains.

After leaving the Brooklyn anchorage we

crossed the river at Fulton Ferry, and visited the office of the engineers having the work in charge. In the office we examined the drawings for the bridge, and had them explained to us.

The construction was commenced Jan. 2nd, 1870. W.A. Roebling, Chief Engineer.

The length of the river span is 1595 ft. 6 ins., from centre to centre of piers. Each land span is 930 ft., making 1860 ft. for both. The Brooklyn approach is 971 ft. The New York approach is 1562 ft. 6 ins. The total length of the bridge is 5989 ft. Width 85 ft. There will be four large cables 15½ ins. in diameter. Each cable consists of 6300 parallel (not twisted) steel wires, No. 7 gauge, closely wrapped into the form of a solid cylinder. The ultimate strength of each cable will be 11 200 tons. The depth of tower foundation below high water, in Brooklyn is 45 ft., in New York 78 ft. The size of towers ~~at~~ high water line, 140 X 59 ft. Tops of towers above high water line 271 ft. tops of balustrades on towers 277 ft. Clear height of bridge in centre of river span above high water, at 50 degs. F. 135 ft. Height of floors, at towers, above high water 119 ft. 3 ins. Grade of roadway 3¼ ft. in 100 ft. The total cost of the bridge exclusive of land acquisition nine million dollars, ($9,000,000). This bridge is being built by the two city governments of New

York and Brooklyn.
The towers are built of granite and limestone; the granite is brought from Maine, Rhode Island, and New Jersey; the limestone, mostly from the Hudson River, and Lake Champlain.
After leaving the office we ascended to the top of the New York tower, by means of a rough stairway which is built up on one side of the tower. We had a good view of the country around for several miles. After remaining up on the tower for 15 or 20 minutes, we descended, and crossed Fulton Ferry and returned on board the Mayflower at about 3 P.M.

Aug. 19. At about 9 A.M. the "Mayflower" left the wharf at the Brooklyn Navy Yard, and started for New Bedford, Mass. Passed through Hell Gate and Long Island Sound.

Aug. 20. At 8.25 A.M., anchored in Buzzards Bay, off New Bedford, near the "Constellation". Was on duty in the lower engine room, from 6 to 8 A.M. Was on duty as Officer of the Day, from 4 to 8 P.M.

Aug. 21. The cadets were drawn up on the port side, under arms, and saluted Rear-Admiral Rodgers, as he passed out to the "Constellation", in his barge.
At 3.40 P.M., got up anchor an steamed

down the Bay after the Constellation. Anchored in Vineyard Haven or Holmes Hole, at 7.25 P.M.

Aug. 22. Went ashore at about 10 A.M.; returned on board at about 12.30 P.M. At about 12 M. the "Mayflower" was signaled by the "Constellation," and at 2 P.M. got under way, and steamed to New Bedford where we came to anchor at 5 P.M.

Aug. 23. Four of the cadets, Annan, Baker, Bowles, and Scribner, left the ship at 6.30 A.M., on leave for one week. Went ashore, at New Bedford, at 10 A.M.; returned on board at 12.30 P.M. At 1.55 P.M. Admiral Rodgers came on board, and at 3.30 he left.

Aug. 24. At about 9 A.M. went ashore with four other cadets, under charge of P.A. Engineer Jones, for the purpose of making sketches of coal hoisting apparatus; returned at about 10.30 A.M.
At about 11 A.M. the "Mayflower" got under way and steamed out to the "Constellation"; took the "Constellation"'s hawser and began towing her, but on account of the engine not working properly the hawser was let go, and the "Mayflower", after a slight delay, proceeded to Newport. Made fast to the wharf at Goat Island, at about 6 P.M.

Aug. 25. Went ashore, and visited the torpedo station on Goat Island. We examined several shells and cans in which the explosive material is put. The shells for the service torpedoes were cylindrical in form, with hemispherical ends; they were made of cast iron, and were of two sizes; the larger weighed about 210 lbs., and had a charge of 100 lbs. of powder; the smaller weighed 140 lbs., and had a charge of about 75 lbs. of powder.

We saw some small torpedoes that are to be used by the steam launch "Lightning"; these torpedoes are spherical in shape, and are made of thin steel covered with tin; they are about 10 ins. in diameter.

The cast iron service torpedoes have a spindle passing through them about 3 ins. in diameter; this spindle is hollow and is perforated with small holes, and is covered with wire gauze to prevent the powder from sifting through into the spindle. Inside of the spindle, at one end of it, is an ignition tube filled with rifle powder; inside of the ignition tube is the igniter; this is exploded by means of two copper wires which are connected with an electric battery; the wires pass through a small piece of wood, at one end of the igniter; the ends of the wires are connected by ~~wrapped with~~ a piece of platinum-silver wire; the platinum wire is wrapped with gun cotton, the gun cotton being surrounded by fine powder

and enclosed in a copper case. The platinum-silver wire is composed of 66 % of platinum and 34 % of silver; it is No. 40 gauge. We also saw a Harvey torpedo; it is of the form of a right parallelopiped, about 4 feet long, 2 ft. high, and 8 ins. thick. The torpedo is towed through the water by means of a rope from the cross-jack yard, and usually moves through the water at an angle of 45° to the direction of the ship; the direction is regulated by means of a bridle which consists of four ropes, one fastened to each of the four corners of the torpedo on the side nearest to the ship; this bridle acts the same as a bridle on a kite, by regulating the angle at which it moves. One of the Harvey torpedoes, when charged, weighs about 40 lbs. more than the amount of water displaced; the torpedo is attached to ~~supported on~~ two cork buoys, and has two levers for exploding it; ~~one of the levers is connected by a line to the ship; the other~~ the levers ~~is~~ are worked by coming in contact with a ship's bottom or side. The lever causes the torpedo to explode by pressing down a pin into the torpedo; this pin ~~is~~ strikes a fuse, ~~it is hollow and~~ which contains a mixture of Chlorate of potash, nut galls, and white sugar; in the end of the fuse is a small glass bulb containing a drop of sulphuric acid; when the pin is pressed down the glass is broken and the sulphuric acid mixes with the chlorate of potash, nut galls,

The Harvey torpedo is an English invention; the right to manufacture it has been bought by the U. S. Government.

and white sugar, and causes them to ignite and explode the torpedo.

We examined and saw in operation one of Prof. Farmer's dynamo-electric machines, which are used for exploding torpedoes. This machine has two keys; by pressing one of them a bell is rung if the electric current is unbroken; the other key is used to explode the torpedo.

We saw a spar, on the end of which four or five torpedoes containing charges of 75 lbs. of powder had been exploded without injuring the spar, and which was completely shattered by a torpedo containing 25 lbs. of dynamite.

We saw another spar on the end of which a torpedo had been exploded; this spar had a shoulder cut on the end of it and a broad ring fitted to it so that the ring was flush with the outside of the spar. The explosion forced the ring from its place, over the shoulder and about four inches further on the spar than the shoulder was cut; the shoulder was not injured in the least, the edges were as sharp as before the explosion, and were not bruised in any way, although when we saw the spar it was larger at the shoulder than under the ring, as will be seen by the sketch.

good

Before Explosion.


After Explosion.

It is supposed that the end of the spar was compressed by the water at the time of the explosion.

We were shown an electro-magnetic machine for producing the electric light. This machine was invented by Prof. Farmer and produces at 1000 feet, alight equal to that of 1000 candles, and at a distance of 8000 feet a light equal to that of 800 candles.

We visited the battery cellar where we saw a great many different kinds of batteries. There are about 17 miles of wire in use about the island, underground and under water; about 5 miles of wire are under water. In the same building there is a key board by which the different batteries can be connected with any station. We saw in the same room an electric light, and had several experiments performed for our benefit. An electric current was passed through a copper wire, and while the electric current was passing through the wire it was magnetized and picked up iron filings. The filings arranged themselves perpendicular to the wire. As soon as the electric current was shut off the wire ceased to be a magnet. We saw a clock-work arrangement for the purpose of firing torpedoes at regular intervals. We saw some nitro-glycerine exploded on a rock, and some dynamite burned in the open air; the dynamite burned without exploding.

At the laboratory we were shown several experiments by Prof. Hill; and had explained to us the method of manufacturing nitro-glycerine; this was very well explained by the means

The electric light that we saw was operated by Siemen's Machine, and was equal to 2500 candles.

of photographs thrown on a screen by a stereopticon. The principal place of manufacture of nitro-glycerine is at North Adams, Mass. In making nitro-glycerine a mixture, of 2 parts of sulphuric acid to 1 part of nitric acid, is placed in pitchers, and pure glycerine allowed to drip into the pitchers from jars placed above; a tube leads into the pitcher, and through this tube a stream of air is blown to keep the mixture in a state of ebullition and cause the glycerine to mix thoroughly with the sulphuric acid and nitric acid; there are 2 parts of nitric acid to one of glycerine. The pitchers are surrounded by ice, to keep down the temperature and prevent the glycerine from being burnt up. After the nitro-glycerine is made it is washed, to remove the acid. The nitro-glycerine is put in a tub with water, and a current of air is blown through a pipe leading nearly to the bottom of the tub; the air stirs the nitro-glycerine up so as to wash it thoroughly; this process is repeated several times until the acid is entirely washed out. After each washing the water is drawn off by means of cocks, the nitro-glycerine remaining on the bottom of the tub. Dynamite consists of 3 parts of nitro-glycerine, and one part of silicious earth (by weight.) Nitro-glycerine freezes at about 40°; it is very explosive when liquid, but does not explode when frozen; it can be transported with safety when frozen. We were shown a photograph,

(by means of the stereopticon and screen), of several cans of frozen nitro-glycerine that were mixed up with a great number of other cans of nitro-glycerine (not frozen) that exploded; the cans containing the frozen nitro-glycerine were very much torn and bruised, and thrown for some distance, but none of them exploded.

Nitro-glycerine is 8 times as powerful as gunpowder. We were shown three different kinds of gun cotton; the ordinary kind which looks like common cotton, compressed gun cotton, and granulated gun cotton. We saw specimens of the common and compressed gun cotton burn; the granulated gun cotton will not burn or explode until it is dried. Gun cotton burns in the open air and leaves no residue, and makes no smoke; when confined it explodes with great violence if ignited.

We were shown several bottles containing picrate of potassium, picrate of sodium, picrate of barium, and picrate of ammonium.

We returned on board of the "Mayflower" at about 1.30 P.M. The cadets were granted general liberty in the afternoon. I went ashore in Newport and with several other cadets took a surf bath.

Good

Aug. 26. At about 2.40 P.M. Admiral Rodgers came on board and the Mayflower left the wharf

and steamed down to Narragansett Pier, where she arrived at about 3.50 P.M., and came to anchor. Admiral Rodgers went ashore and returned at about 5.30 P.M. when the "Mayflower hoisted anchor and returned to Goat Island, arriving at about 6.45 P.M. N

Aug. 27. The cadets were granted general liberty from after quarters until sun-down; I went ashore at about 3 P.M. and went down to the beach with several other cadets and took a surf bath; returned on board at about 6 P.M. N

Aug. 28. The "Mayflower" left Newport at about 9 A.M. and arrived in Providence at about 12.30 P.M. and anchored in the stream. At about 2 P.M. hoisted anchor and hauled into the wharf opposite which she was lying. At about 5.40 a tug came alongside and towed the Mayflower to another wharf. N

Aug. 29. All of the cadets went ashore and visited the Corliss Steam Engine Works; on the way there we passed through the boiler shop of the Providence Steam Engine Co., where we saw four large boilers which were being made for the U. S. S. "Lancaster"; these boilers, like those for the "Alaska" and class, and the "Juniata", have no water bottoms. We were shown

through the Corliss works by Mr. Corliss. The first thing that we noticed was the foundation on which were cut the gears for the large Corliss engine at the Centennial Exhibition; twelve gears were cut to be used at the Centennial, and one extra one, making thirteen in all. The extra gear is interchangeable with each of the twelve; it was made to be used in case any of the twelve should get out of order. The gear cutting machine, which was made expressly for cutting these gears, cost $4000. We examined, and had explained to us by Mr. Corliss, a large Corliss pumping engine; ~~this engine is of the kind known as compound;~~ it works ten pumps, 12 ins. in diameter and 15 ins. stroke; the engine is 12 ins. in diameter and 4 ft. stroke. This pump will pump 1 5000 000 gallons in 24 hrs., when making 50 revolutions per minute. In the machine shop we saw a large pit in which gears are cut, and a large lathe on which was turned the base plate for the first Monitor. In the foundry we saw three large cupolas, and had explained to us the construction of the roof; there is very little, or no framing in this roof, all of the timbers being spiked together, and fastened with bolts, and rods, and iron shoes. The roof has but seven inches rise; in the centre and running the whole

length of the building is a heavy truss; this truss is supported by the large cranes which are used for moving the work; these cranes although they support the roof are very easily swung around. In one of the shops we saw the rim of a large pulley, 7½ ft. face and 30 ft. diameter. It is intended for an engine of 900 H.P., and is fitted for 3 belts. This pulley has a rise of about 3/8 ins. on the face; each band having a rise of about 3/16 ins. When we were shown this wheel Mr. Corliss mentioned that the large wheel at the Centennial Exhibition weighed 56 tons. We saw two large engines of which the pulley mentioned above is a part; we examined the shaft bearings of these engines; the bearings are fitted with Babbits metal, and are made in four parts; the part A, as shown

A & being called the sides brasses

in the sketch, has the edge c rounded off so that it can be removed without moving the shaft. The Babbit metal in these bearing is made by the Corliss Co. These engines are being built for a cotton mill in Lowell Mass. We examined a large cast iron crank; on account of its being made of cast iron, the crank is rather large in proportion to the size of the shaft and crank pin. The crank pin is not shrunk in, but is forced in by a pressure of about 100 tons,

by means of a large screw. The crank is counterbored; and after the pin is forced in it is upset on the end. The crank pins, and the two end centres on the working beam at the Centennial Exhibition are made of scrap iron covered with tool steel about 3/8 ins. thick; this will take a very high temperature without being affected. After forging the cover on, it is turned up and then hardened as much as possible and ground. The collars for these pins are made separate from the pins. Mr. Corliss mentioned that at the Centennial Exhibition he has 800 ft. of underground shafting fitted with slip couplings to allow for contraction.

We examined a large hammer in the forging shop; the metal is moved from the furnace to the hammer by means of a large iron crane which is worked by steam; this crane is anchored, by means of heavy rods, to a frame work of wood which is placed underground; wood is used, in the frame work, in preference to stone or iron on account of the jar caused by the hammer. We saw a large forging of a shaft 20 ins. in diameter, which was intended for exhibition at the Centennial Exhibition.

We examined a very large pumping engine of double the capacity of the first one that we saw; this was a compound engine. We also examined several Corliss cylindrical

boilers.
We left the Corliss Works at about 1 P.M. and went to the works of the American Screw Co. We first visited the room in which the wire has the scale removed from it; (by means of oil of vitriol and water) from there we went to the annealing room, and then to the room in which the screws are headed. The wire is cut in lengths after the head is put on the end. In another room there are a great many machines which do nothing but cut a slot in the head and finish it. In this way the screw passes through a great many different departments before being finished. We went through all of the departments and examined all of the machines that were in operation. At present they are making 20000 gross of screws per day at these works; they can make as many as 40000 gross. About 8 tons of wire are used per day. We visited what is called the museum where we saw models of nearly every machine that has ever been used in the manufacture of screws. From the museum we went to the model room, where models of the different parts of the machinery are kept. We visited another part of the works where rivets and small bolts are made. The machinery in this part of the works is run by a large

Corliss engine. After leaving the works of the American Screw Co., we visited the Mt. Hope Water Works where we examined the engines and boilers. The engines have an automatic arrangement by which the speed of the engines is increased when the hydrants in the city are opened; this is to keep up the supply in case of fire. One of the engines, the one that we saw in operation, was manufactured by the Providence Steam Engine Co., and takes steam from boilers made by the same company. The other engine was manufactured by the Corliss Steam Engine Co., and is the same as the first one that we saw at the Corliss works. The Corliss engine takes steam from a Corliss boiler. The Corliss pump is worked by five engines; there is but one eccentric, which works 20 valves 10 exhaust and 10 steam valves. Did not take many notes concerning these pumps as the man who was in charge did not appear to be certain about anything that he told us concerning their capacity &c.

After leaving the Water Works we returned on board the Mayflower at about 3.30 P.M.

EF

Aug. 30. Went ashore at about 9 A.M. and visited the Providence Tool Co.'s works. This company has a contract for making 600000 Peabody-Martini rifles for the Turkish government. We went through that part only of the works

in which the rifles were being made. The machinery is run by 2 large Corliss engines. All of the parts of the rifles, except the barrels, are forged by means of drop hammers with dies. We saw the hammers in operation in the forging shop. The hammers used in forging the small parts weigh from 400 to 600 lbs.; those used in forging the larger parts weigh about 900 lbs. We saw several furnaces for annealing and case hardening the material, after forging. To case-harden them, the parts are placed in iron boxes, in a mixture of oil bone dust, burnt leather, and a small quantity of charcoal; these boxes are placed in the furnace and heated; when sufficiently heated the boxes are emptied into cold; in emptying them, the boxes are placed with the top edges in contact with the water before emptying; this is done in order to prevent the air from getting at the metal and forming a scale on it, and destroying the color. After being annealed the parts are placed in a mixture of oil of vitriol and water, in order to remove the scale. We went through the entire works in which the rifles are made, and examined the different machines that are used in making the different parts; one of the parts, the receiver goes through 58 different operations be-

fore being finished. The Peabody-Martini rifle is the same as the Martini-Henry rifle. These works can turn out 4000 rifles per week. We returned on board at about 11.45 A.M. General liberty on shore was granted to all of the cadets until 9 P.M.

Aug. 31. Left the wharf, at Providence, at about 9.45 A.M., and steamed down to Newport where we arrived at about 12.15 P.M. At about 1 P.M. we hoisted anchor and steamed to New London, Conn., where we arrived at about 7.05 P.M., and came to anchor.

Sept. 1. The cadets were granted liberty on shore from 10 A.M. until 3.00 P.M. Hoisted anchor and got under way at 5.45 P.M., for New York

Sept. 2. At 6.35 A.M. came to anchor near Hell Gate, and waited for the tide to turn until 8.15, when we weighed anchor and steamed through the pass; we proceeded up the Hudson, and arrived at Cold Spring at 6 P.M.

Sept. 3. Remained on board all day. The cadets were granted liberty on shore during the afternoon.

Sept. 4. All of the cadets went ashore at Cold Spring, and visited the West Point Foundry, Paulding Kemble & Co. proprietors.

Incorrect

We first examined some machinery for sugar mills. The juice of the cane is boiled in large vacuum pans; below the vacuum pans is a long iron box or trough with a shaft running length-wise through it, and on this shaft are a great many small screw propellors which by being revolved draw the sugar from the vacuum pans and pass it down into the drying pans that are placed under the trough. The drying pans are cylindrical in form, and placed inside of them are three separate cylinders one within the other. The outside cylinder is made of composition, and perforated with holes about 1/4 in. in diameter; the inside cylinder is made of fine wire gauze, and the one between is made of coarser wire gauze. The pans are made to revolve very rapidly; this causes the water to fly off through the gauze, and leave the sugar dry.

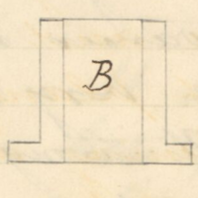
We also examined different parts of two large engines for a grain elevator. We were shown the parts of a machine for elevating sugar; it worked very much the same as a chain pump.

We were next shown the manner of converting smooth bore into rifled guns.

The smooth bore guns are bored out a little larger than they originally are, and are fitted with a wrought iron sleeve; an 11-inch smooth bore gun makes an 8-inch rifled gun. The wrought iron sleeve is made of bar iron twisted around a mandrel into coils. At the West Point Foundry the bars that are used are about 18 ft. long; the bars are taken from the furnace when they are hot enough, and one end of the bar is made fast to a mandrel that revolves and winds the bar into a coil; the hot bar passes between the threads of a large screw before being wound round the mandrel; this screw acts as a guide.

A

On account of the bars of iron not being long enough the sleeve is made of several coils, the coils being about 2 ft. or 2 ft. 6 ins. in length and of the shape shown in the sketch A.

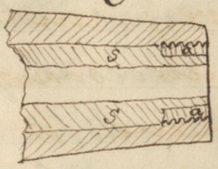


The coils are heated and welded under the hammer in pots as shown in sketch B; these pots preserve the cylindrical form of the coils; in this welding the coil is changed from a coil into a cylinder. These cylinders are afterwards butt welded together to form a sleeve. In butt welding them the cylinders are not removed from the furnace; they are welded by the pressure of a large screw.

In the sketch C is shown the method of

securing the sleeve at the muzzle of the gun.

C



S is the sleeve. A thread is cut on the inside of the muzzle and the ring a screwed on. D is a section of the ring showing the form of thread used. The sleeve is rifled before being put in the gun.

G

G is a sketch of conical shot for 8-inch guns; these shot are fitted with a brass ring having a groove c cut in it; the hot gases entering this groove cause the ring to expand and fit the bore of the gun; the shot is chilled from the point to the line a

We examined a large gun (a 100 pounder) that was being converted into a breech loader. We also examined and saw in operation a hydraulic machine for planing shot; the shot is placed in a die and this die by being forced over the shot planes it off. The same amount of planing is done in 30 seconds by this machine that would require about one hour on an ordinary planer or lathe. In the forging shops we saw a very large steam hammer weighing 8 tons. We saw a very large pulley for an elevator engine; the spokes of this wheel were of wrought iron with the rim and hub cast on them. In the machine shop we saw a rifling ma-

chine in operation. In the foundry we saw several large flasks for casting guns; these flasks are of boiler iron, and they are made in sections; we also saw several flasks for casting shot; the guns and shot are cast standing on end, the guns with the muzzle up, and the shot with the base up and the point down; the bottom of the mould for shot is made of cast iron so as to chill the point of the shot. In the Lobdell Car Wheel Works, at Wilmington Del., we were told that charcoal iron was the only kind that would cause a casting to chill; we were told at the West Point foundry that anthracite iron would chill, but that charcoal iron was the best. We examined a large gun with a hydraulic buffer. And in the office of the works we saw a gauge for measuring the calibre of guns, and examined several drawings. We returned on board the Mayflower at about 1 P.M.

FJ

Sept. 5. The cadets went ashore, and visited the West Point foundry, at about 9 A.M., for the purpose of making sketches; all hands returned on board at about 12 M. At about 1 P.M. the anchor was hoisted and the Mayflower steamed up to Newburgh. In the evening nearly all of the cadets attended a "Centennial Tea Party" at General Washington's Headquarters, liberty on shore

being granted until 11.10 P.M. L.J.

Sept. 6. All of the cadets went ashore at about 8.30 A.M., and took the train for Greenwood, where they visited the smelting furnace of R.P. & Peter P. Parrott. We arrived at the works just in time to see the operation of running the hot metal from the furnace into pigs.

The furnace is 55 ft. high, 7 ft. in diameter at the top, and 16 feet in diameter near the bottom in the largest part. called the bosh

One charge for this furnace consists of 2000 lbs. of coal, 2500 lbs. of ore, and 1100 lbs. of limestone; the coal is put in first and the ore on top of the coal, the limestone being put in on top of the ore. As soon as one charge has burned another is put in. This furnace has been in operation for over five years without a single stoppage. There are 30 charges put in the furnace every twelve hours

The ore used at these works is not all of the same kind; every 2500 lbs. put in consists of five different kinds of ore in equal parts.

The poorest ore yields about 35% of iron; the richest yields about 65%; the mixture of five different kinds yields about 50% of iron.

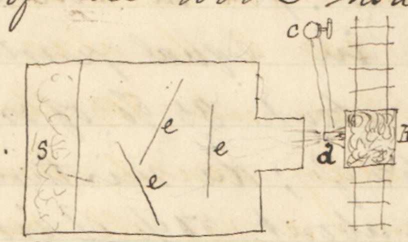
The steam for running the machinery is furnished by three boilers, 112 ft. long and 36 ins. in diameter. These boilers are heated by the hot gases from the top of the furnace. The press-

ure in the boilers is kept at 70 lbs. to the square inch. The hot blast has a pressure of 5½ lbs. to the square inch and a temperature of 600° Fahr.

There are three blowing engines in use at the works. One of the engines has a cylinder for steam 24 ins. in diameter and 5 ft. stroke, and works two double acting air pumps. The second pump has but one air cylinder and is worked by steam; the third pump has two air cylinders and is worked by water power.

After examining the furnace and works for smelting the iron, we were shown the method of making mineral wool. This mineral wool is made from the slag or refuse taken from the furnace. The slag is run off into cars holding about 2500 lbs. each, and the car is run on a track to the wool house, where the red hot slag is allowed to run from the car and pass over a jet of steam; as soon as the slag strikes the jet of steam it is converted into wool, being blown inside of the wool house. A is a plan of the wool house. C is the steam pipe connected with the boiler, and having in it a valve to turn on the pressure. d is the trough into which the slag runs from the car; this trough is placed directly over the steam jet that blows directly into the wool house. K is the

A.



B.

B is a section of the wool house.

car from which the slag runs. e, e, e, are iron plates suspended inside of the house to prevent the shot from going back, and being mixed with the wool. When the slag is blown into the house it is in two forms; the greater part takes the form of wool; the other part is in the form of shot; these shot vary in size from an ordinary bird shot to a grain of sand. The fine wool is blown up and back and settles on the large shelf S. The shot, on account of their weight, after being blown against the iron screens fall to the ground along with a part of the wool. When the blowing is going on the inside of the house presents the appearance something like a snow storm. All of the wool, even the finest and best contains a great many fine shot. The wool and shot are composed of the same thing but in different forms; they are nothing but glass. The wool at the first glance has the appearance of ordinary wool and the difference is only seen on a closer examination; it is in a fleecy form, but if pressed it loses this form and cannot resume it, on account of the fibre being very short. One car of the slag containing 2500 lbs. of the slag is blown into 300 lbs. of wool; the same amount of slag would produce more wool but that the slag is not all red hot when it reaches the steam jet. Mr. Parrott says that if the slag was allowed to run directly from the furnace to the steam jet it would all be converted into wool; he does not adopt this method because

the one that he uses at present supplies the demand for the wool. The wool house is lined inside with sheet iron. The wool is a new invention and it is not known yet for what purposes it may be used. It is a non-conductor of heat.

After examining the process of making wool we examined several piles of ore that were being roasted; each kind of ore is roasted separately. The ore is roasted by setting fire to the wood and fine coal placed under the pile. The process of roasting takes four or five weeks, and costs 20 cents per ton of ore.

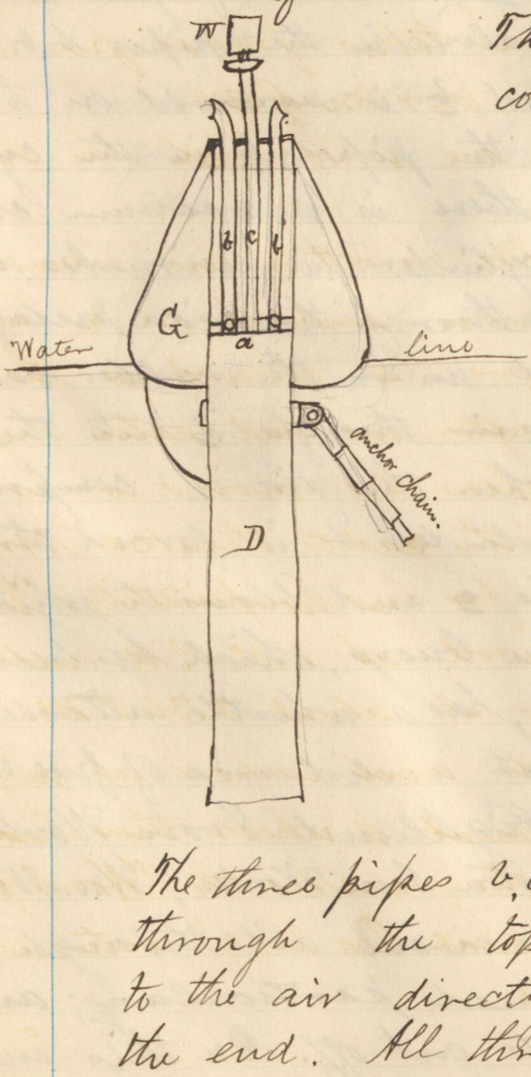
In smelting if the ore is too rich the furnace will not work well.

We were invited by Mr. Parrott to his house, some distance from the furnace, and up on a high hill. When we arrived there he allowed us the liberty of his vineyard, and after we had eaten a great many very fine grapes he invited us in to have lunch. Three of the cadets thanked Mr. Parrott, in behalf of the class, for his hospitality. We left the station at Greenwood at 1.03 P.M. and arrived on board the Mayflower at about 2.30 P.M.

Nearly all of the cadets went ashore at night to attend an entertainment to which they had been invited, after which they visited the "Headquarters" and attended the "Centennial Tea Party", returning on board at about 12 Mid.

AB

Sept. 7. All of the cadets went ashore at 8.30 A. M. and visited the Highland Iron Works, Ward Stanton & Co., proprietors. The first thing that we saw was a small locomotive built for the Peekskill Iron Works, and to be used in bringing ore from the mines to the works; the cylinder is 9x12 ins.
We next examined a large buoy which was so constructed as to blow a whistle by the motion of the waves.



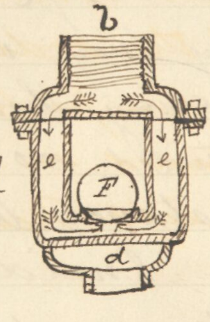
The buoy, as shown in the sketch, consists of a large cone like an ordinary buoy with a cylinder passing through it and extended so as to go some distance below the water. Inside of the cylinder and above ~~the~~ water line ~~the diaphragm~~ there is a diaphragm a which acts as a tube sheet for the three pipes b, b, and c. The cone G is air tight. The cylinder D is closed at the upper end and open at the bottom.

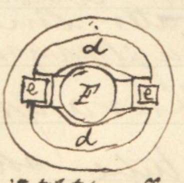
The three pipes b, b, and c pass upward and out through the top of the cylinder; b, b, opening to the air directly, and c with a whistle on the end. All three of the pipes open downward into the cylinder; c directly and b, b, by means

of valves arranged with rubber balls. When the buoy rises up out of the water it creates a partial vacuum in the cylinder D between the diaphragm and the water, and the air rushes in through the pipes b, b, the valves in them being opened by the pressure from without not being balanced within. When the buoy sinks in the water the air is forced out through the pipe c and blows the whistle W. The figure A is a section through the valve in the pipes b. b.

The end b is screwed on to the end of the pipes b in the cylinder. When there is a vacuum created in the cylinder the air rushes in through b, down through the side passages e, e, and up under the rubber ball and down again through d into the cylinder; when this air is compressed in the cylinder it is forced through the pipe c and blows the whistle W.

fig. A





View with top taken off.

One of these buoys, which has been anchored off Sandy Hook, has a whistle attached to it which is heard at a distance of five miles. After leaving the Highland Iron Works we went to the Washington Iron Works, Wm. Wright & Co., proprietors. We went all through these works, and examined particularly an engine with Wrights cut off. On this engine the valves are worked by means of a set

of levers, the levers being worked by an arm attached to a rock shaft. There is a steam valve on the side of and at each end of the cylinder; each valve is attached to a vertical valve-stem working in a dash pot underneath; each valve stem has a slot cut in with a cam fitted into the slot; a lifting toe, at each end of the system of levers, works in the slot and by working under the cam raises the valve. The cut off is regulated by regulating the length of the toe, which is done by means of a rod connected with a system of levers and worked by the governor; the governor is of the ordinary kind.

We saw a great many air pumps for compressing air for rock drills. We returned on board the Mayflower at 10 A.M., and left Newburgh at 10.30 A.M.

2J

Theophilus.